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STUDIES IN THE RANUNCULACEAE OF THE SOUTHEASTERN UNITED STATES. VI. MISCELLANEOUS GENERA[1,2]

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In providing a treatment of the Ranunculaceae for the forthcoming *Vascular Flora of the Southeastern United States*, a number of nomenclatural and taxonomic decisions were made which call for additional clarification (see Keener, 1975, for a general rationale governing these studies). This treatment of various smaller genera is deliberately conservative and I have attempted to note those species deserving careful biosystematic study.

Within the southeastern United States, Ranunculaceae is represented by 18 genera and 93 species which compares to 50-70 genera and 2000-4000 species for the world (Buchheim, 1964; Zimmermann, 1965). The following key to the genera native or naturalized within the southeastern United States also includes three genera (*Adonis, Helleborus, Nigella*) which occasionally escape from cultivation, but are not considered sufficiently well established to be included in a regional floristic treatment. In previous papers I presented notes on *Aconitum, Anemone, Clematis, Consolida, Delphinium, Ranunculus*, and *Thalictrum*; these genera, although included in the key given below, are not discussed further.

KEY TO GENERA

1. Flowers actinomorphic, the sepals mostly equal; fruit various.
  2. Leaves opposite; styles of mature fruits usually elongate and plumose . . . . . *Clematis.*
  2. Leaves whorled, alternate or basal; styles of mature fruits not elongate and plumose.
    3. Fruit an achene or utricle; carpels 1-ovuled.
      4. Sepals short-spurred; leaves basal, linear; fruiting receptacles more than 1 cm long . . . . . *Myosurus.*
      4. Sepals not spurred; leaves various, rarely basal and linear; fruiting receptacles usually less than 1 cm long.
        5. Petals present, usually showy.

[1] Based on a manuscript and notes compiled for the forthcoming *Vascular Flora of the Southeastern United States*. The area covered in this treatment is bounded by and includes Louisiana, Arkansas, Kentucky, West Virginia, Maryland, and Delaware. In general, the format follows Radford et al. (1967). Any suggestions for improving this treatment should be sent to me so that necessary corrections can be made before the *Vascular Flora* is in press.

[2] Contribution No. 134 from the Department of Biology, The Pennsylvania State University.

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6. Petals basally nectariferous; leaves not finely dissected (except in several aquatic species); terrestrial and aquatic . . . . . *Ranunculus.*
6. Petals lacking basal nectaries; leaves finely dissected; terrestrial (introduced species sporadically escaped from cultivation) . . . . . *Adonis.*

5. Petals absent, the sepals or filaments often well-developed.
7. Leaves ternately compound or decompound, the leaflets usually distinctly petiolulate; flowers often unisexual . . *Thalictrum.*
7. Leaves simple, often deeply parted, or if compound, the leaflets scarcely petiolulate; flowers usually bisexual.
8. Leaves cauline, alternate; involucral leaves (bracts) absent; fruit a dehiscent utricle . . . . . *Trautvetteria.*
8. Leaves basal, except for the opposite or whorled involucral leaves subtending the flowers; fruit an achene.
9. Involucral leaves entire, sepaloid, closely subtending (less than 3 mm) the petaloid calyx . . . . . *Hepatica.*
9. Involucral leaves compound or deeply divided (the leaflets or segments variously toothed, lobed or dissected), remote from the flowers . . . . . *Anemone.*

3. Fruit a follicle or berry; carpels at least 2-ovuled.
10. Plants small shrubs; inflorescences paniculate, drooping . . . . . *Xanthorhiza.*
10. Plants herbaceous; inflorescences not paniculate, the flowers racemose or solitary.
11. Largest leaves simple, variously toothed to deeply palmately lobed.
12. Sepals 3; ovules 2; fruit a berry . . . . . *Hydrastis.*
12. Sepals more than 3; ovules more than 2; fruit a follicle.
13. Petals absent; sepals petaloid, usually bright yellow; leaves simple, merely shallowly toothed . . . . . *Caltha.*
13. Petals (staminodia) 2-lipped, hollow; sepals petaloid, greenish-yellow; leaves palmate or pedate (introduced species occasionally escaped from cultivation) . . . . *Helleborus.*
11. Largest leaves ternately compound to decompound or finely dissected.
14. Leaves variously compound with generally broad, toothed or lobed leaflets; carpels distinct.
15. Petals distinctly spurred; flowers variously colored . . . . . *Aquilegia.*
15. Petals absent, or if present, not spurred; flowers usually white.
16. Sepals small, not petaloid, caducous; flowers many, racemose.
17. Carpels 1-8, becoming follicles; flowering racemes elongate, more than 15 cm long . . . . . *Cimicifuga.*
17. Carpel 1, becoming a berry; flowering racemes short, less than 5 cm long . . . . . *Actaea.*
16. Sepals conspicuous, petaloid, not caducous; flowers solitary or few.
18. Petals (staminodia) present, small; follicles long-stipitate; cauline leaves absent . . . . . *Coptis.*
18. Petals absent; follicles sessile; cauline leaves present . . . . . *Enemion.*

14. Leaves finely dissected into narrow segments; carpels basally connate (introduced species sporadically escaped from cultivation) . . . . . *Nigella.*

1. Flowers zygomorphic, the upper (posterior) sepal distinctly unlike the others; fruit a follicle.
   19. Upper sepal hooded or helmet-shaped, not spurred; petals 2(–5), entirely concealed by the hooded sepals . . . . . *Aconitum.*
   19. Upper sepal spurred, not hooded; petals 2 or 4, with at least the limbs exserted.
      20. Carpel 1; petals 2, united; introduced annuals . . . . *Consolida.*
      20. Carpels 2 or more; petals 4, distinct; native perennials . . . . . *Delphinium.*

ACTAEA L., Baneberry

The baneberry genus *Actaea* includes about 10 species widely distributed in the northern hemisphere (Tamura, 1966). Two species are in eastern North America.

1. Berries white (rarely red); mature pedicels stout, more than 1 mm thick; stigmas during anthesis 1–2 mm broad, sessile . . 1. A. PACHYPODA.
1. Berries red (rarely white); mature pedicels slender, less than 1 mm thick; stigmas during anthesis 0.5–1 mm broad, subsessile . . . . . 2. A. RUBRA.

1. A. PACHYPODA Ell., White Baneberry, Doll's-eyes

Rich open woods and thickets; all prov. SE except LA. [ALL except Tex. and Okla.]. Incl. forma *rubrocarpa* (Killip) Fern.—Fernald (1950), a form with red fruits; *A. alba sensu* Small (1933), Gleason and Cronquist (1963), *non* Miller (1768).

The taxonomy of the eastern North American species of *Actaea* is fairly well understood. There are two species which differ chiefly in pedicel thickness, and although both species have red and white fruited forms, within a given species one color predominates (cf. key above). Of the two species, however, the nomenclature for the widespread thick-pedicelled species has not been satisfactorily resolved. At issue is whether the name *A. alba* Miller or *A. pachypoda* Ell. should be applied to this species.

When Linnaeus (Sp. Pl. I: 504. 1753) described *A. spicata* var. *alba* he used no specimens, but merely cited two works in which the plant was previously figured: t. 77 of Cornut's *Canadensium Plantarum Historia* (1635) and ii. fol. 1, t. 2, fig. 7 of Morison's *Plantarum Historia Universalis* (1680) both reproduced by Fernald (1940). Later, when Miller (1768) published the name *A. alba* he gave a brief diagnosis and merely cited Morison (but not Linnaeus) and as Mackenzie (1928) pointed out, " . . . it is not correct therefore to write *Actaea alba* (L) Miller." According to Mackenzie (1928), although Miller grew the plant, no specimen apparently has been preserved.

Mackenzie (1928) maintained that the illustrations by Cornut and Morison (who obviously copied his illustrations from Cornut—see Fernald, 1940) rep-

resented an *Actaea* with ovoid racemes and slender pedicels. He concluded that Cornut, Morison, Linnaeus, and Miller all described the slender-pedicelled white-fruited form which is currently called *A. rubra* (Aiton) Willd. forma *neglecta* (Gillman) Robinson. But Mackenzie never followed through on the nomenclature. Instead of applying the name *A. alba* Miller to the white-fruited form of the slender-pedicelled species which would then have become the name for the species, he regarded the red-fruited form to be more natural ("undoubtdly the specific type") than the rarer white form. Consequently, Mackenzie used the name *A. rubra* (Aiton) Willd. for the species. Finally, there being no earlier available name, Mackenzie applied Elliott's *A. pachypoda* to the thick-pedicelled plants.

Fernald (1940) thoroughly reviewed the nomenclatural history of *Actaea spicata* var. *alba* and concluded that Cornut's illustration was not that of a Canadian plant. Moreover, Fernald pointed out that although Cornut's sketch apparently was based on the European *A. spicata* (a species with black ovoid fruits), the phrase "*baccis niveis*" seemingly referred to North American material. Fernald's conclusion was that inasmuch as "the basis of *A. alba* Mill. was confused," the unequivocal name *A. pachypoda* Ell. should be used instead.

Gleason (1944) agreed with the facts set forth by Mackenzie and Fernald, but he differed sharply with their conclusions. In the first place, Gleason argued that greater weight should be given to the *description* of the fruit. Gleason noted that in the description of his species ("*Aconitum baccis niveis & rubris*"), Cornut included a statement to the effect that "the white berry became 'orbicularis' at maturity and had a purple spot at the summit." This seemingly implied that the plant was from eastern North America, not from Europe. Furthermore, Linnaeus, having no specimen of the North American thick-pedicelled, white-fruited baneberry, based his variety *alba* entirely on Cornut's description and illustrations. Gleason believed that Linnaeus' diagnosis ("β. Aconitum baccis niveis. *Corn. canad.* 76. *t.* 77") clearly singled out the North American white-fruited baneberry by eliminating the European black-fruited *A. spicata* and the American red-fruited *A. rubra*. Consequently, Gleason felt that "*A. alba* (L.) Miller" should be the name applied to the thick-pedicelled, white-fruited baneberry of eastern North America.

After reviewing the evidence, I have adopted *A. pachypoda* Ell. for the thick-pedicelled eastern North American baneberry for the following reasons:

1. Fernald (1940) clearly demonstrated that the sketches of both Cornut and Morison illustrate the European *A. spicata* far better than they illustrate either of the two eastern North American species.

2. Linnaeus' diagnosis (Sp. Pl. I: 504. 1753) for variety *alba* ("β. *Aconitum baccis niveis*") is too brief. It could be applied equally well to the common white-fruited thick-pedicelled species (*A. pachypoda*) or the white-fruited form of the thin-pedicelled species (*A. rubra*).

3. Because no type material for var. *alba* is known to have been preserved, and in view of Linnaeus' inadequate diagnosis, I am relying on the illustrations by Cornut and Morison to clarify matters. Because the illustrations and diagnosis apparently refer to two different taxa, it is best to regard Linnaeus' variety *alba* as a *nomen ambiguum.*

4. Miller's diagnosis (Miller, 1768) is also too brief. The only definite points in his diagnosis are the phrase "*racemo ovato*" and a single reference to Morison's illustration. Because no type material has been preserved so far as is known (Mackenzie, 1928), one is again forced to rely on an illustration which more accurately figures the European *A. spicata* than it does the eastern North American plants.

2. A. RUBRA (Aiton) Willd., Red Baneberry

Rich woods and thickets; chiefly mts. Reported for W.Va.; to be sought elsewhere in the SE. [ALL except Tex. and Okla.] Incl. forma *neglecta* (Gillman) Robinson—Fernald (1950), a form with white fruits; *A. pachypoda* Ell.—*sensu* Radford (1968), *pro parte.*

Actaea rubra ranges over the cooler parts of North America and probably is a species which recently (in post-Pleistocene time) migrated into eastern North America (Kane, 1966). It has been reported for West Virginia (Fernald, 1950), and Tennessee and North Carolina (Small, 1933), but I have seen no specimens. It should be sought in the cool mountainous regions of Maryland, Virginia and West Virginia (cf. Strausbaugh and Core, 1971).

AQUILEGIA L., Columbine

This genus of about 70 species (Munz, 1946) is widely distributed in the northern hemisphere. There are two species in the southeastern United States, one native and one an introduced escape.

1. Spurs straight to curved, not hooked distally; perianth red, yellow or both; stamens conspicuously exserted . . . . . 1. A. CANADENSIS.
1. Spurs strongly hooked distally; perianth blue, purple, pink or white; stamens scarcely exserted . . . . . 2. A. VULGARIS.

1. A. CANADENSIS L., Wild Columbine

Rich rocky woods, ledges, pastures and roadside banks; all prov. SE except La. and Miss. [ALL]. Incl. *A. coccinea* Small—Small (1933), *A. c.* var. *coccinea* (Small) Munz—Fernald (1950), *A. australis* Small—Small (1933), *A. c.* var. *latiuscula* (Greene) Munz—Fernald (1950).

Munz (1946), who revised the genus on a worldwide basis, recognized five varieties of *A. canadensis* although he admitted that "there is abundant intergradation and many specimens are difficult to place." Until thorough biosystematic studies involving comparative population analyses are undertaken to assess the overall geographic variability, I prefer to recognize

A. canadensis as a wide-ranging polymorphic species.

2. A. VULGARIS L.

A garden escape occasionally established along roadsides, waste places and fields; mts. and pied. NC., W.Va. [Pa., N.J.].

Although Munz (1946) provided a key and description to 24 varieties of this species, most seem to be mere trivial variants based on flower color and size, leaflet shape, size and dissection, pubescence, etc. Consequently, no attempt has been made to account for them in our flora.

CALTHA L., Marsh-Marigold

One of the most primitive genera within the Ranunculaceae, *Caltha* is a worldwide, generally extra-tropical genus of ca. 20 species (Tamura, 1966; Buchheim, 1964), one of which occurs throughout arctic and eastern North America and Eurasia.

1. C. PALUSTRIS L.

Wet woods, wet meadows, marshes and bogs; chiefly mts. Del. cp., Md., N.C., Tenn., Va., W.Va. [Ill., Ind., Ohio, Pa., N.J.].

This species varies considerably with respect to "habit, size, shape of leaf and follicle and in chromosome number" (Tutin, 1964). Kootin-Sanwu and Woodell (1971) analyzed the cytogenetic relationships of various chromosome races and concluded that *C. palustris* 1) is sexually reproducing with the plants self-incompatible, 2) consists of a number of chromosome races with a base number of 8 [the 2n=32 race is common in North America; 2n=56 race the only one in Britain; other races in Europe include 2n=16, 28, 48, 60, 72 plus many aneuploids], 3) by means of polyploidy, hybridization and obligate outbreeding coupled with vegetative reproduction has become a highly successful species now widely established in wet habitats throughout the northern hemisphere, and 4) "is interesting in that there exist well-defined, partially or completely isolated chromosome races which if morphologically distinct could be regarded as separate species, but which must, on present evidence, be regarded as one." In view that the eastern North American plants are an apparent uniform 2n=32 race, it would be of interest to analyze those populations consisting of slender plants with small flowers and broadly reniform leaves formerly recognized as *C. flabellifolia* Pursh (Pursh, 1814) [= *C. palustris* var. *radicans* (Forst.) Beck—see Smit, 1973]. For a comprehensive treatment of *Caltha*, see Smit (1973).

CIMICIFUGA L., Bugbane

Ramsey (1965), who studied the genus from a comprehensive perspective, recognized 12 species widely distributed throughout the northern hemisphere, of which three are in eastern North America.

1. Carpels 1(–2), sessile; follicles firm-walled.
   2. Follicles ca. 7 mm long, the seeds smooth; petals (staminodia) present; leaflets 20 or more per leaf . . . . . 1. C. RACEMOSA.
   2. Follicles ca. 16 mm long, the seeds scaly; petals (staminodia) absent; leaflets 3–9(17) per leaf . . . . . 2. C. RUBIFOLIA.
1. Carpels 3–8, stipitate; follicles thin, papery . . . 3. C. AMERICANA.

1. C. RACEMOSA (L.) Nuttall, Black Cohosh

Rich moist woods, wooded slopes, ravines and thickets; all prov. SE except La. and Miss. [ALL except Tex. and Okla.]. Incl. *C. r.* var. *cordifolia* (Pursh) Gray—*sensu* Fernald (1950), *pro parte*, and forma *dissecta* (Gray) Fern.—Fernald (1950).

Plants with extremely dissected leaves have been named forma *dissecta* (Gray) Fern., but such variants appear to be unworthy of taxonomic recognition. With respect to variety *cordifolia*, see the discussion under no. 2 below.

2. C. RUBIFOLIA Kearney

Wooded limestone river bluffs, ravines and coves; chiefly mts. Tenn. mts. and IP, Va. [Ill.]. Incl. *C. racemosa* (L.) Nuttall var. *cordifolia* (Pursh) Gray—*sensu* Fernald (1950), *pro parte*.

Cimicifuga rubifolia, a relatively rare and poorly understood species, was described by Kearney (1897) to include the unicarpellate, sessile-ovaried plants with large deeply cordate leaflets which he collected near Knoxville, Tennessee.

Much earlier, Pursh (1814) described *C. cordifolia* which over the years was applied (e.g. by Gray, 1895, and Fernald, 1950) to robust forms of *C. racemosa* with subcordate leaflets as well as elements referable to *C. rubifolia* Kearney (Ramsey, 1965). However, even though Pursh's *C. cordifolia* was apparently based on a plant having deeply cordate leaflets, the type description (Pursh, 1814) clearly points to a species earlier described by Michaux as *C. americana* (Ramsey, 1965). Hence, Pursh's *C. cordifolia* is a synonym of *C. americana* and Gray (1895) and Fernald (1950) simply misapplied the name.

3. C. AMERICANA Michaux

Rich moist wooded slopes and coves; mts., rarely pied. Ga., Ky., Md., N.C., S.C., Tenn., Va., W.Va. [Pa.].

COPTIS Salisbury, Goldthread

Apparently a relict genus, *Coptis* consists of about 14 species widely distributed throughout the cooler parts of the north temperate zone (Tamura, 1968).

1. C. TRIFOLIA (L.) Salisbury

Rich damp mossy woods and bogs; mts. Md., W.Va. [Ind., Ohio, Pa., N.J.]. Our material can be segregated as var. *groenlandica* (Oeder) Fassett

[*C. groenlandica* (Oeder) Fern.—Fernald (1950)].

On the basis of available herbarium material, Fernald (1929) treated the plants of Greenland and Atlantic North America as *C. groenlandica* and distinct from *C. trifolia* which he considered restricted to eastern Asia and Alaska. Fernald did remark, however, that possible transitional populations might lead to a reclassification. Hultén (1937), in comparing specimens from the Aleutians and southeastern Alaska, concluded that plants from the Aleutians coincided with material from Kamtchatka, whereas those from southeastern Alaska apparently were more closely related to plants from Greenland. Because of these more or less transitional populations, Hultén treated the material from southeastern Alaska to British Columbia, eastern North America, and Greenland as *C. trifolia* subsp. *groenlandica* (Oeder) Hultén which was later reduced by Fassett (1946) to varietal status. Although I prefer to regard *C. trifolia* as a single wide-ranging species, those who recognize regional variants can segregate our material as *C. trifolia* var. *groenlandica* (Oeder) Fassett.

ENEMION Raf., False Rue Anemone

The delimitation of taxa within the Tribe Isopyreae Schrödinger, demarked by small chromosomes (x=7) and follicular fruits (Tamura, 1968), has long been unsettled. Drummond and Hutchinson (1920), who thoroughly reviewed the taxonomic history of *Isopyrum* and its close allies, recognized seven genera, including *Enemion* which was originally described by Rafinesque (1820) to accommodate newly discovered plants somewhat resembling the common Rue Anemone (*Thalictrum thalictroides* (L.) Eames & Boivin). Although Torrey and Gray (1838, p. 29) initially recognized Rafinesque's genus, in the Supplement to their Flora (vol. 1, p. 660, 1838) they transferred *Enemion biternatum* to *Isopyrum* as well as firmly delimiting it from the European *I. thalictroides* L. of which it had at one time been considered a mere apetalous form (Drummond and Hutchinson, 1920). In the latest revision of this group, Tamura and Lauener (1968) likewise recognized *Enemion*, along with four other closely related genera (*Dichocarpum*, *Isopyrum*, *Leptopyrum* and *Paraquilegia*). Of these, only *Enemion* lacks petals, which, along with its several free carpels having transverse veinlets, led Tamura (1968) to consider it as the most primitive genus within the Isopyreae.

However, not all recent workers accept the generic segregation of *Enemion*. For example, Calder and Taylor (1963) believe Drummond and Hutchinson (1920) misinterpreted the petaloid structures of *Isopyrum* as petals instead of interpreting them as staminodia and moreover placed " . . . too much stress on their value as characters for segregation of the genera." Nevertheless, irrespective of whether one wishes to call these structures staminodia or petals (cf. Tamura, 1965; Cronquist, 1968: 81), the taxonomic question is whether the absence of these structures is sufficient for a generic segregation of *Enemion* from *Isopyrum sen. lat.*

As recognized in this paper, *Enemion* has six species, distributed in North America and eastern Asia (Calder and Taylor, 1963); one of these, *E. biternatum* Raf., is in eastern North America.

1. E. BITERNATUM Raf.

Rich moist woods, rare; chiefly cp. and pied. Ala., Ark. mts., Fla., Ky. IP, N.C., S.C., Tenn. pied., W.Va. [Okla., Mo., Ill., Ind., Ohio]. *Isopyrum biternatum* (Raf.) T. & G.—Small (1933), Fernald (1950), Gleason and Cronquist (1963), Radford (1968).

HEPATICA Miller, Liverleaf, Hepatica

Although some authors unite *Hepatica* with *Anemone* (e.g. Hiroe, 1957; Hara, 1962; Ohwi, 1965), I regard *Hepatica* as a distinct genus, chiefly on the basis of the position of its involucral bracts which closely subtend the flowers.

There has been some difference of opinion regarding the taxonomic treatment of the eastern North American hepaticas. Current regional manuals (e.g. Fernald, 1950; Gleason and Cronquist, 1963; Radford, 1968) generally recognize two species, *H. acutiloba* and *H. americana*. However, critical studies by Hara and Kurosawa (1958) and by Julian and Cora Steyermark (1960) established that *H. nobilis* Miller *sensu lato* is widely distributed in three disjunct regions in the north temperate zone (Europe, eastern Asia, eastern North America). The European plants are only slightly variable whereas those in eastern Asia are the most polymorphic of all and include the only known tetraploid race (Hara, 1962).

With respect to the eastern North American populations there are two relatively distinct forms, which apparently hybridize where they are sympatric (Steyermark and Steyermark, 1960). On the basis of their herbarium studies, the Steyermarks (1960) concluded that "it is, therefore, a matter of difficulty to distinguish some of the European forms of *H. nobilis* from one or the other of the two American taxa." Intensive biosystematic research, including comparative breeding studies should be undertaken to resolve the evolutionary relationships within the *H. nobilis* complex. However, pending such research, I am following the preliminary work of the Steyermarks in recognizing the eastern North American hepaticas as regional varieties of the European *H. nobilis*.

1. H. NOBILIS Miller

Two varieties are recognized following Steyermark and Steyermark (1960).

1a. Var. OBTUSA (Pursh) Steyermark

Leaves cleft to about the middle of the blade; apex of leaf lobes and bracts rounded to obtuse. Sepals typically bluish (sometimes white or pink). Rich woods and dry upland slopes, often in acid soils; all prov. SE except La. and Miss. [ALL except Tex. and Okla.]. *H. hepatica* (L.) Karsten—Small

(1933); *H. americana* (DC.) Ker.-Gawl.—Fernald (1950), Gleason and Cronquist (1963), Radford (1968).

1b. Var. ACUTA (Pursh) Steyermark

Leaves parted to below the middle of the blade; apex of leaf lobes and bracts acute. Sepals typically whitish. Upland woods and rocky slopes, often in calcareous soil; chiefly mts. and pied. Ala., Ark., Ga., Ky., Md., N.C., S.C., Tenn., Va., W.Va. [Mo., Ill., Ind., Ohio, Pa.]. *H. acuta* (Pursh) Britton—Small (1933); *H. acutiloba* DC.—Fernald (1950), Gleason and Cronquist (1963), Radford (1968).

HYDRASTIS Ellis ex L., Golden Seal, Orangeroot

This monotypic genus (Janchen, 1949; Tamura, 1968), restricted to eastern North America, was once widely used in homeopathic medicine. For example, Lloyd and Lloyd (1884), who devoted over one hundred pages in discussing its botanical characteristics and medicinal properties, estimated that the total annual production (ca. 1880) reached nearly 75 tons of rhizomes and roots. Due to such extermination plus its rather exacting ecological requirements, *Hydrastis* is now quite rare and definitely needs protection.

1. H. CANADENSIS L.

Rich woods, rare; chiefly mts. SE except Ala., Fla., La. [Mo., Ill., Ind., Ohio, Pa.].

MYOSURUS L., Mouse-tail

The specialized and phyletically advanced genus *Myosurus* consists of about 16 species widely distributed in all continents, although it is absent in eastern Asia (Tamura, 1967). Campbell (1952) recognized four species native to North America, one of which (*M. minimus*) also occurs in South America, Europe, Australia, and New Zealand. For a study of reproductive biology, meiotic and mitotic behavior, see Stone (1959, 1960).

1. M. MINIMUS L.

Low fields in alluvial or calcareous soil; chiefly cp. and pied. Ala., Ark., Ky. IP, La., N.C., S.C., Tenn., Va. cp. [Tex., Okla., Mo., Ill., Ind.].

According to Campbell (1952), *M. minimus* consists of eight subspecific taxa, one of which (subsp. *minimus*) alone occurs in eastern North America.

TRAUTVETTERIA Fischer & Meyer, False-Bugbane

This genus is disjunct in eastern Asia, western and eastern North America (Tamura, 1967), and consists of one to three or more species, depending on the taxonomic treatment.

1. T. CAROLINENSIS (Walter) Vail

Wooded seepage slopes, stream banks and bogs; chiefly mts. Ala., Ga., Ky., Md., N.C., S.C., Tenn., Va., W.Va. [Mo., Pa.].

XANTHORHIZA Marshall, Yellow-root

This monotypic genus, confined to the southeastern United States, is distinguished by its woody habit, drooping paniculate inflorescences and yellow wood (whence the name).

Although a number of authors (e.g. Buchheim, 1964) use the spelling *Xanthorrhiza* (following recommended transliteration of classical Greek in the formation of compound words), I am retaining the spelling originally adopted by Marshall (1785), a practice recommended by Stern (1966, p. 269).

1. X. SIMPLICISSIMA Marshall, Yellow-root

Shaded stream banks, moist woods, thickets and rocky ledges; all prov. Ala., Ga., Ky. mts., Md. cp., Miss., N.C., S.C., Tenn., Va., W.Va.

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THE POLLEN MORPHOLOGY OF DALEA SECTION CYLIPOGON[1] (PSORALEAE: LEGUMINOSAE)

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ABSTRACT—Pollen grains of *Dalea* section *Cylipogon* are described by scanning electron microscopy. This section consists of ten species; nine are discussed here. In this section there are three definite pollen types. Two types are clearly distinct while the third is intermediate. The first type is spherical, highly reticulate with anomotreme apertures. The second is prolate, finely reticulate with tricolpate apertures. The intermediate type has three different forms, two prolate and a subprolate form.

The genus *Dalea* is a heterogeneous group which is presently being revised by R. C. Barneby. An investigation of the pollen morphology of *Cylipogon* was initiated for two reasons; first, to support the segregation of these species into a section and second, to clarify the species boundaries of these taxa, if possible.

The proposed section *Cylipogon* is composed of ten species with similar morphological characteristics. The pollen of the following *Dalea* species have been examined:

D. aurea Nutt.
D. jamesii T. & G.
D. luisana S. Wats.
D. wrightii Gray
D. hallii Gray
D. laniceps Barneby
D. nana Torr.
D. parrasana Brandg.
D. prostrata Ort.

The tenth undescribed species is known only by the fruiting form. Voucher specimens are listed in Table I.

MATERIALS AND METHODS

Pollen grains were prepared by a modification of the standard acetolysis method devised by Erdtman (1952, 1960). The pollen material was not centrifuged but was allowed to settle out of the medium. This technique greatly increased the quantity and quality of the pollen yield. Pollen prepared for scanning electron microscopy was washed in 75% ETOH until all visible traces of the acetolysis solution were gone.

[1] A description of *Dalea* section *Cylipogon* will be published in a revision of genus *Dalea* by R. C. Barneby, currently in manuscript (Mem. N. Y. Bot. Gard. vol. 27).

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The washed pollen was deposited on the nonadhesive side of metallic tape, attached to aluminum stubs and allowed to air dry. The desiccated pollen was then coated with gold-palladium and examined with a MSM-2 Mini-SEM and AMR-1000.

RESULTS

The pollen morphology of *Cylipogon* is of three types. *D. aurea* and *D. nana* characterize the first pollen type. These species possess very similar but not identical pollen grains. The pollen of both species is highly reticulate with spherical structures underlying and connecting the reticulations. The grains of both species are spherical with anomotreme apertures. The specific aperture patterns of the pollen grains can be used to distinguish these species. *D. aurea* is characterized by at least two forked apertures whereas *D. nana* has only one forked aperture and a donut-shaped aperture. (Figs. 1, 2 and 5)

The second pollen type is represented by *D. halli*, *D. jamesii*, *D. laniceps*, *D. prostrata*, *D. parrasana* and *D. wrightii*. The pollen grains of these species are almost identical. They cannot be separated morphologically by shape, by reticulation or by aperture type, position and number. Polar lengths may be helpful but these measurements are not available. The pollen of this group is prolate, tricolpate with a finely reticulate sexine. (Figs. 3 & 5)

D. luisana characterizes the third pollen type. The pollen of this species is predominately prolate but some grains are subprolate. All mature grains have a reticulated sexine similar to the second pollen type. Three distinct aperture arrangements have been found. One of the patterns is a tricolpate grain similar to pollen group two. (Figs. 4 & 5) The second aperture arrangement is formed by three colpate apertures merging at a single equatorial point producing a forked effect. The third form seems to be a distortion of the previous arrangement. Three undulating apertures merge at the approximate pole of the subprolate grain rather than at the equator. The apertures appear similar to those of *D. aurea* and *D. nana* because of the undulations and the forked junction.

DISCUSSION

The pollen morphology of the section *Cylipogon* shows a continuum of pollen types from a prolate, tricolpate grain (*D. hallii*) to a spherical anomotreme grain (*D. aurea*). *D. luisana* appears to be the intermediate pollen type because of its variability and aperture distortion. Certain pollen grains of *D. luisana* are prolate tricolpate while others are distorted to subprolate anomotreme grains. *D. luisana* pollen grains represent the intermediate forms connecting the two extremes. Thus, section *Cylipogon* seems to be a natural taxon.

Three of the nine species examined can be conclusively identified on the bases of their pollen morphology. They are separated in the following manner:

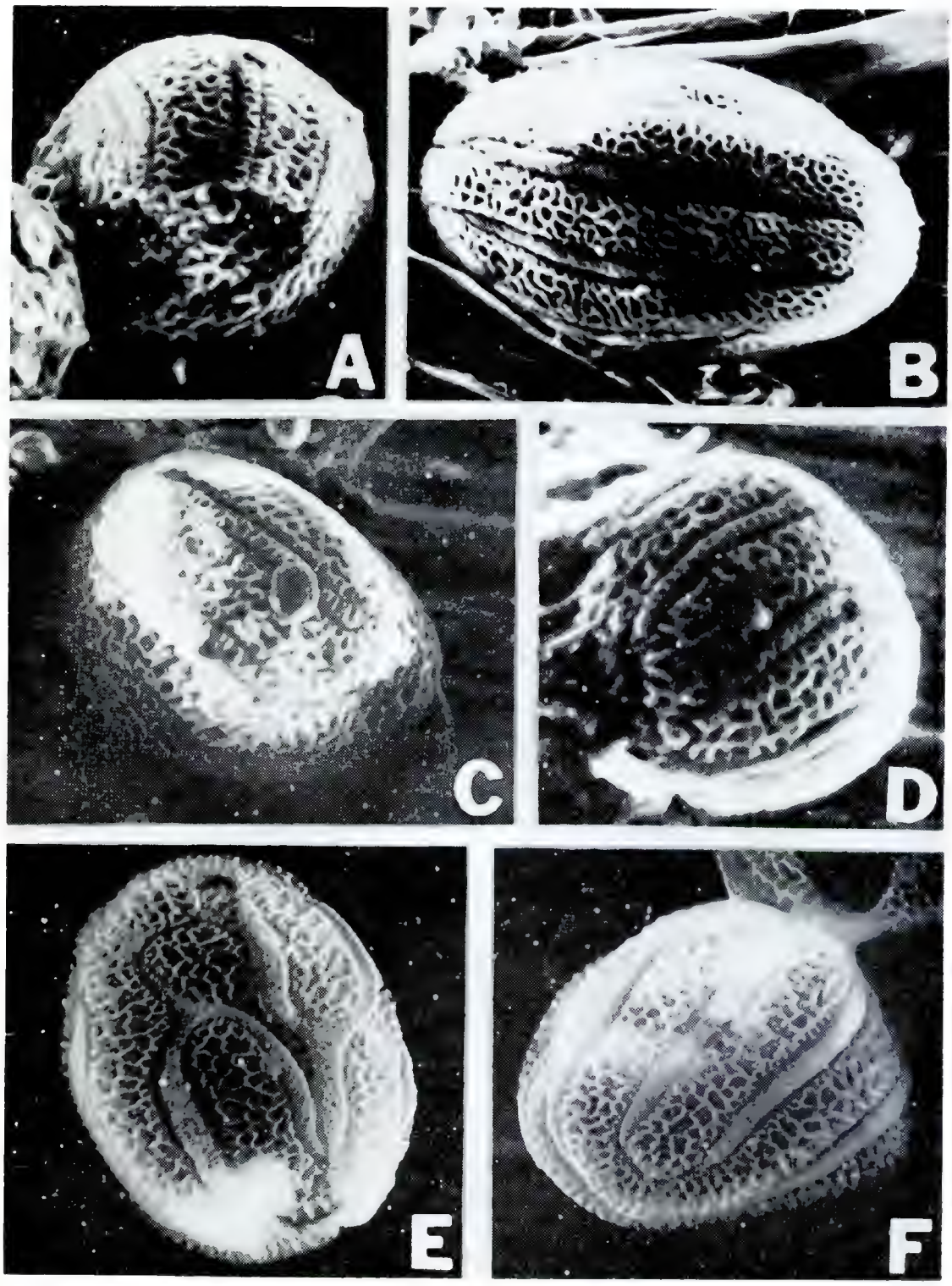

Fig. 1. *Dalea aurea.* A. 1000x, B. Note that the grain has collapsed slightly, 1250x, C. 1000x, D. 1125x, E. Note two forked apertures, 1425x, F. 1500x, Note that A. & C. are the same grain from the rear and front.

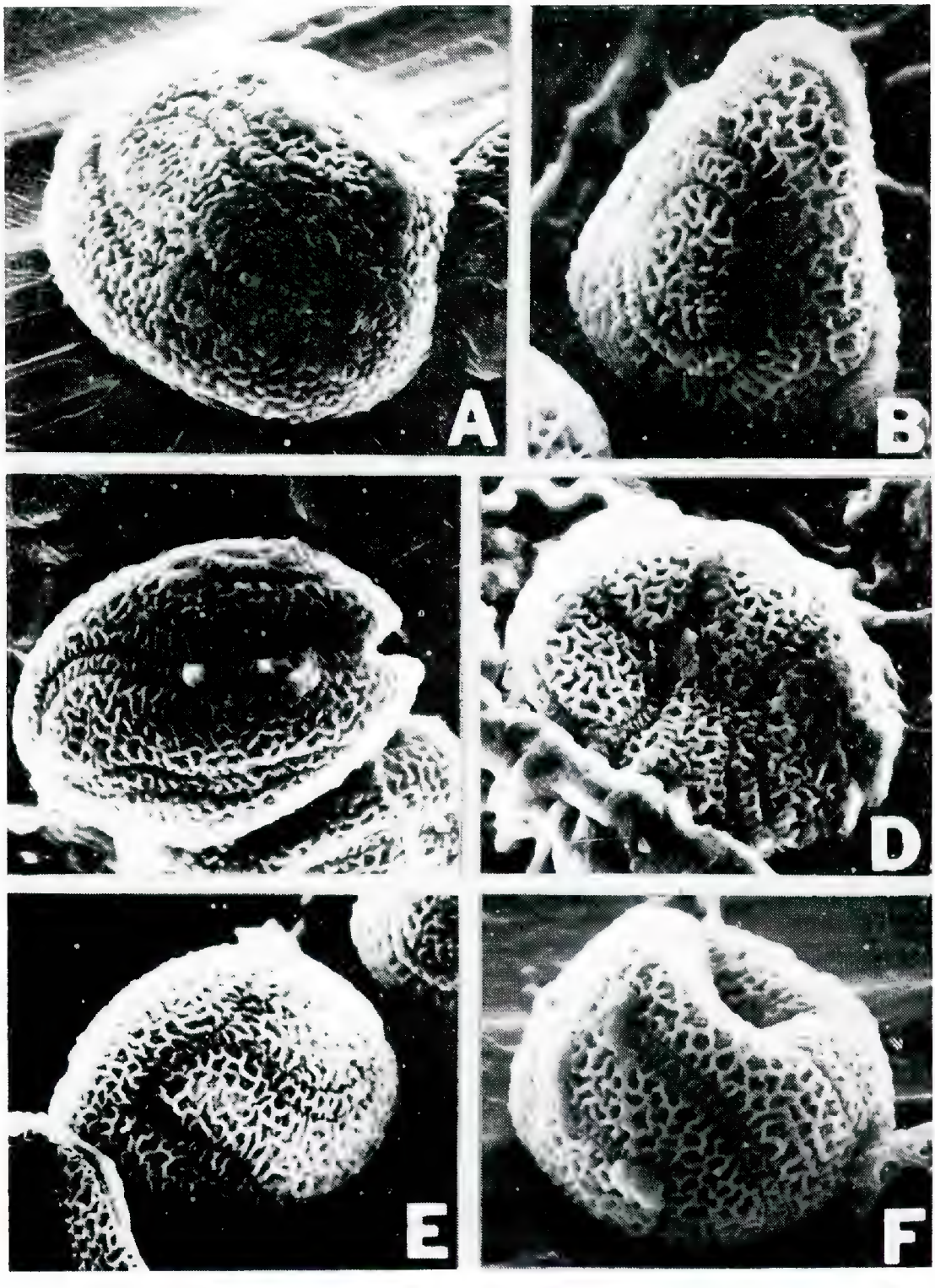

Fig. 2. *Dalea nana*. A. 1375x, B. Note donut-shaped aperture, 1875x, C. 1125x, D. Note forked aperture, 1250x, E. Note forked aperture, 1375x, F. 1500x.

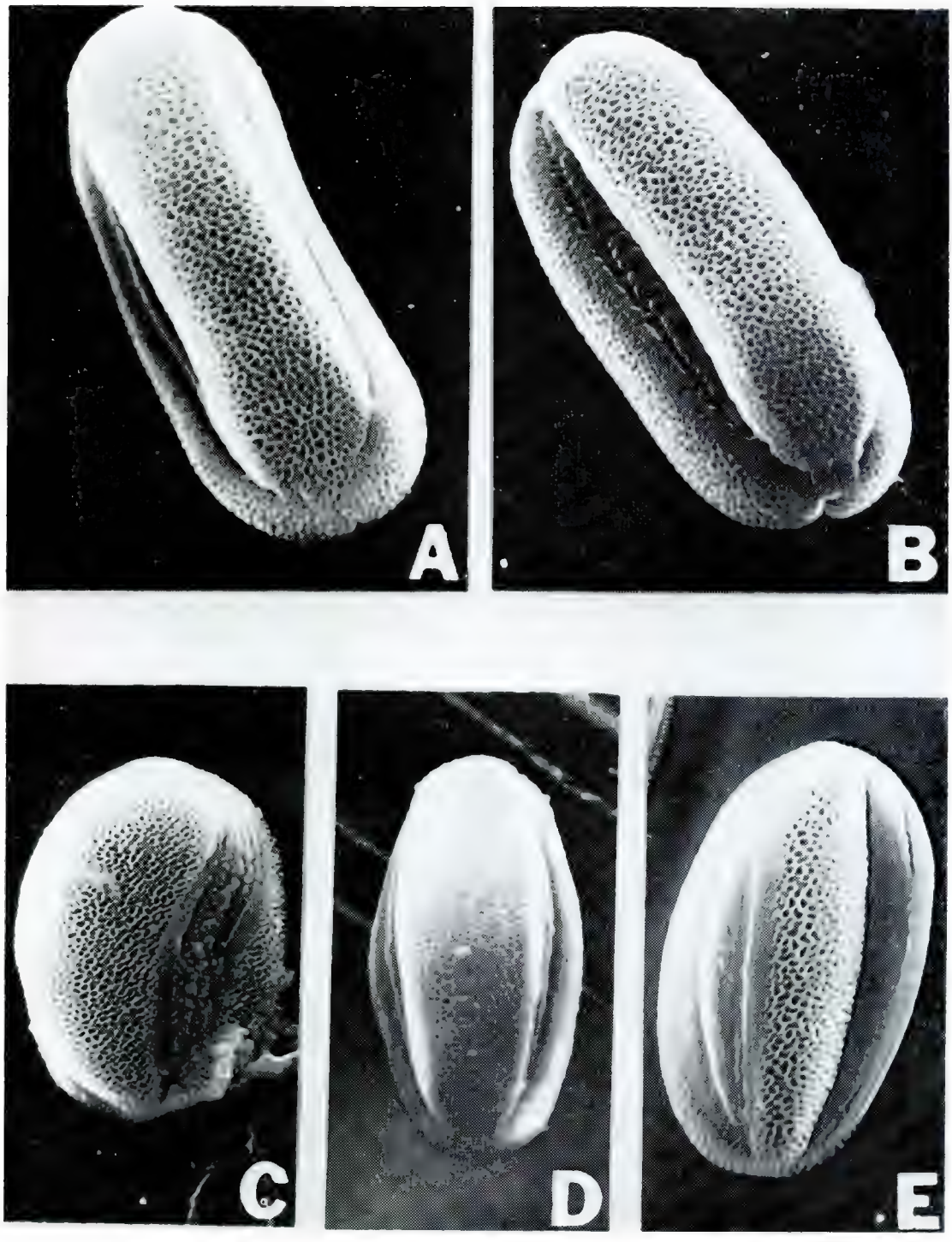

Fig. 3. Pollen of group two. Note shape and tricolpate condition.
A. *Dalea jamesii*, 2438x, B. *D. Hallii*, 2250x, C. *D. laniceps*, 1425x, D. *D. prostrata*, 1625x, E. *D. wrightii*, 1625x.

1. Spherical; sexine highly reticulate; spherical protrusions between the reticulations.
   2. Two forked apertures present; donut-shaped aperture absent . . . . . *D. aurea.*
   2. One forked aperture; one donut-shaped aperture present . *D. nana.*
1. Prolate to subprolate; sexine finely reticulate; spherical sexine protrusion absent.
   3. Grains tricolpate . . . . . *D. hallii, D. jamesii, D. laniceps, D. prostrata, D. parrasana, D. wrightii.*
   3. Grains with three merging colpate apertures and grains with tricolpate apertures . . . . . *D. luisana.*

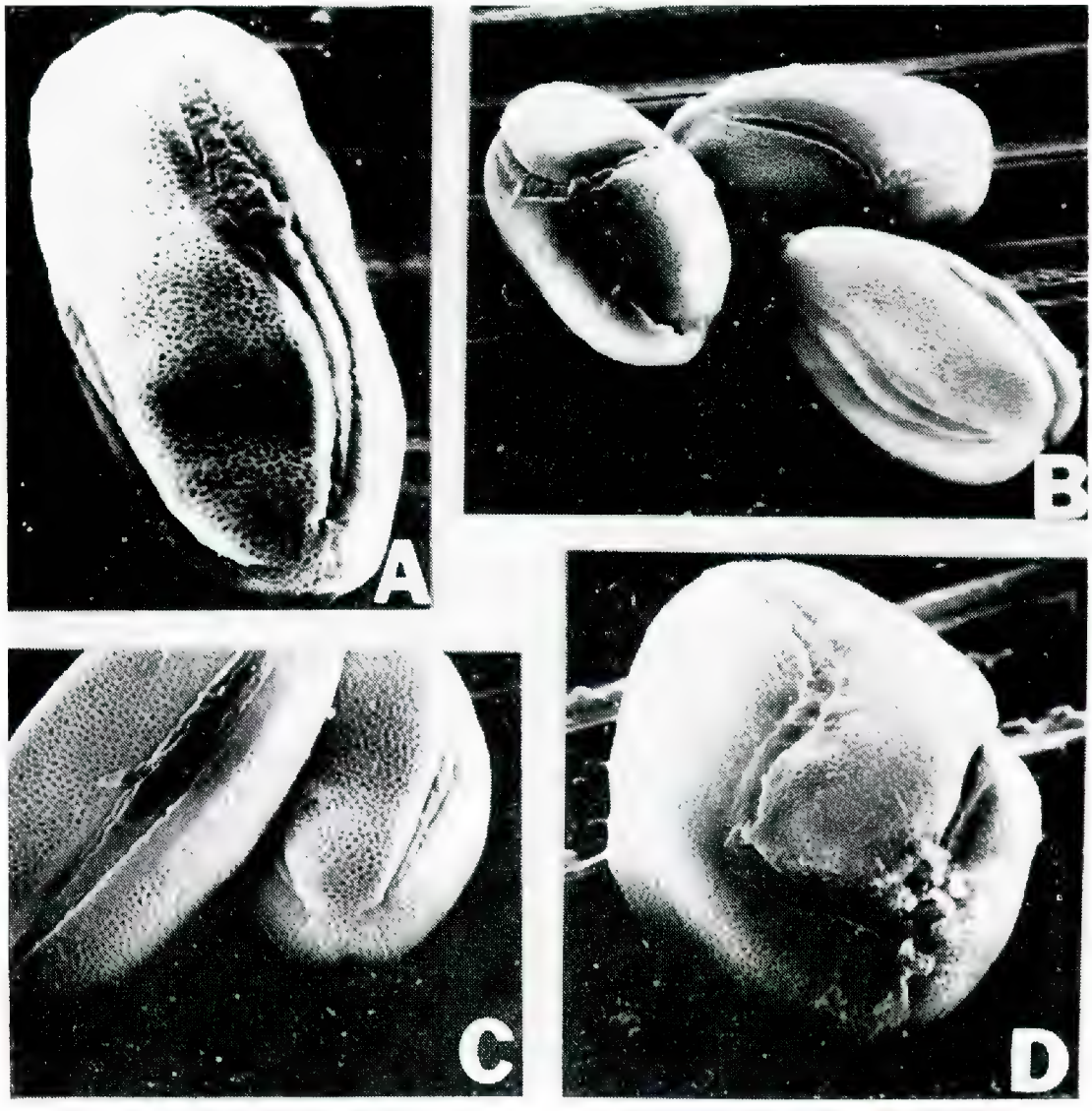

Fig. 4. *Dalea luisana.* A. Note tricolpate apertures, 2000x, B. Note colpi merging at the equator, 1125x, C. Note the number of furrows and the aperture, 1688x, D. Note undulating colpi merging and the shape of the grain, 1875x.

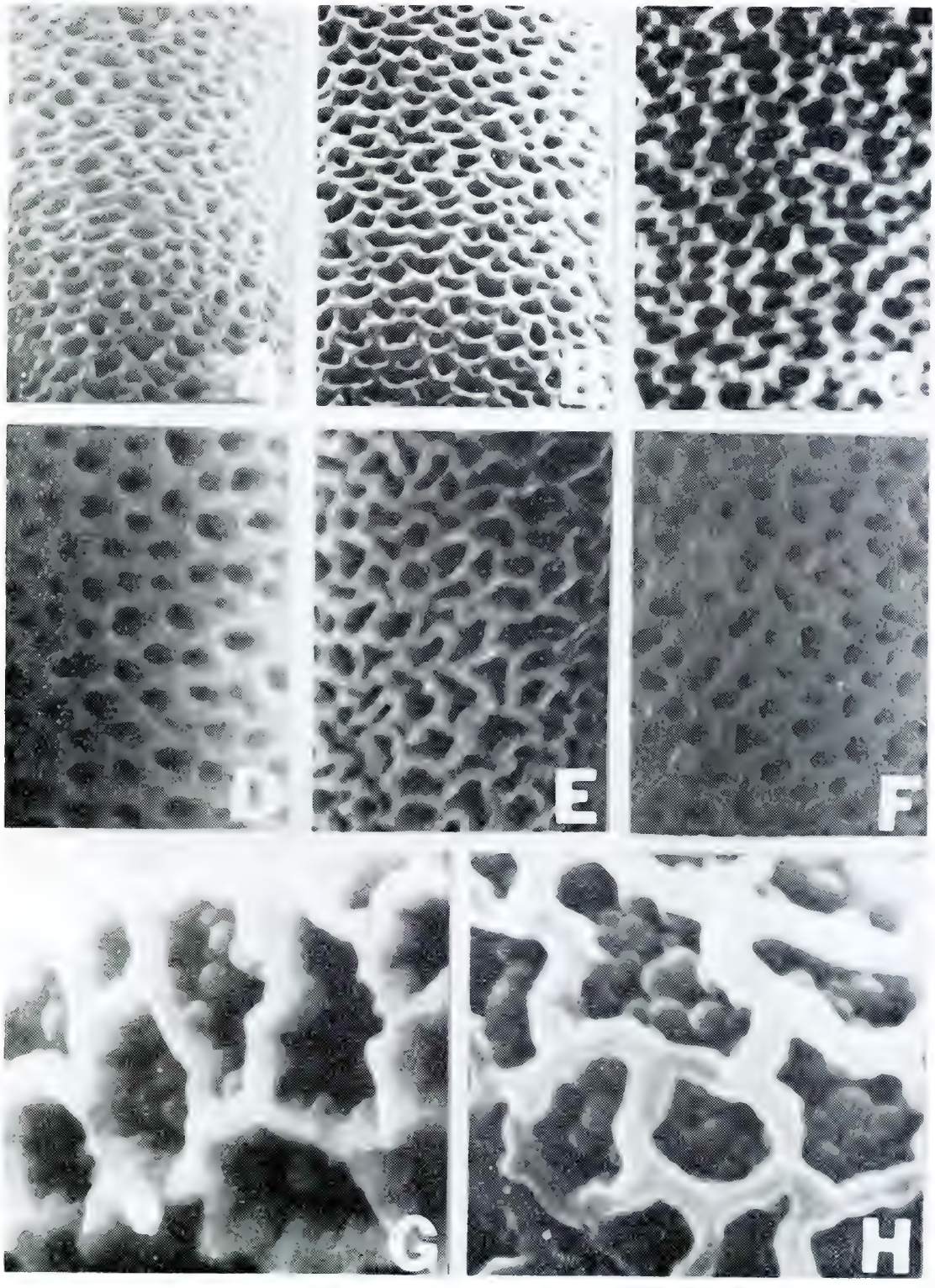

Fig. 5. Reticulation in section *Cylipogon*. A. *Dalea hallii*, 6125x, B. *D. jamesii*, 6125x, C. *D. laniceps*, 6500x, D. *D. prostrata*, 11875x, E. *D. wrightii*, 6875x, F. *D. luisana*, 11800x, G. *D. aurea*, Note spherical protrusions between ridges, 12500x, H. *D. nana*, Note spherical protrusions between ridges, 10625x.

Table I. Voucher Specimens for *Dalea* section *Cylipogon*

Taxa	Collector	Location	Herbarium
D. aurea Nutt.	C.L. York, 54389	Bell Co., Texas	SMU
	M.J. Trlica & D.V. Sellers, 115	Carson Co., Texas	NY
	S. Hewitt, 23	Comanche Co., Texas	SMU
	D.S. & H.B. Correll, 12995	Cooke Co., Texas	SMU
D. hallii Gray	B.L. Turner, 1845	Dallas Co., Texas	SMU
D. jamesii T. & G.	J. & C. Taylor, 3715	Cimarron Co., Oklahoma	SMU
D. laniceps Barneby	Ripley & Barneby, 14962	Coahuila, Mexico	NY
D. luisana S. Wats.	Ripley & Barneby, 14768	San Luis Potosi, Mexico	NY
D. nana Torr.	F.R. Waller, 1412	Deaf Smith Co., Texas	SMU
	J.W. Thieret, 30891a	Brewster Co., Texas	SMU
	L.H. Shinners, 32284	Menard Co., Texas	SMU
D. parrasana Brandg.	Ripley & Barneby, 13282	Coahuila, Mexico	NY
D. prostrata Ort.	Ripley & Barneby, 13940	Chihuahua, Mexico	NY
D. wrightii Gray	SMU-DMNH, 102	Brewster Co., Texas	SMU

Absolute measurements of the major axis of the prolate, tricolpate grains may provide information which can be used to separate these taxa.

ACKNOWLEDGEMENTS

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A NEW SPECIES OF *CHAETOPAPPA* (ASTERACEAE-ASTEREAE) FROM NORTH CENTRAL MEXICO

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Collections in the Chihuahuan Desert region of north central Mexico by Prof. M. C. Johnston and collaborators have revealed a number of novelties, one of the rarer being the new species described here.

CHAETOPAPPA **plomoensis** Turner, sp. nov. (Fig. 1).
Herbae perennes 9–13 cm altae. Laminae foliorum spathulatae supra glabrae. Ramuli inflorescentiae primarii secundariique tenues sinuati foliis paucis squamiformibus. Setae pappi ca. 25, 2–3 mm longae.

Small perennial, 9–13 cm tall. Leaves alternate, mostly basal, on tufted offshoots from a slender, ramifying root system; blades spatulate, sparsely pubescent beneath, glabrous above, the margins appearing ciliate. Flowering stems delicate, bearing 2–13 heads, in habit very similar to *C. parryi* Gray except that the primary (and secondary) branches are spindly or sinuate, these bearing fewer and much-reduced, scale-like, leaves. Technical characters of the head are also surprisingly like that species except that the cup-like crown of short scales is wholly replaced by a pappus of ca. 25 setae which are 2—3 mm long.

HOLOTYPE: MEXICO. Coahuila; La Cuesta del Plomo on the Músquiz-Boquillas highway (28°44′ N., 102°31′ W.), 1750—777 m, steep limestone slopes and canyons. *F. Chiang, T. Wendt & M. C. Johnston 9218b.* 14 Sept. 1972 (TEX; known only from the holotype which comprises 5 plants; each of these has the characteristic leaves and pappus).

At first glance the collections concerned would appear to be depauperate forms of the fairly widespread *Chaetopappa parryi.* However, the pappus is strikingly different and, combined with habital and leaf differences, the taxon seems worthy of recognition. It is apparently a local, bluff-inhabiting, endemic, much like *C. hersheyi* Blake, which is known only from the Guadalupe Mountains of western Texas. In Shinners' (1946) revision of the genus, *C. plomoensis* would key to *C. parryi*, but the latter has strongly erect, quite leafy, flowering branches, leaves which are pubescent on both surfaces and, of course, a small, squamellate, crown-like pappus, the latter being consistent in the numerous specimens examined, both at the University of Texas (TEX) and elsewhere (MO, US).

I am grateful to Prof. M. C. Johnston for the Latin diagnosis and partial support from his NSF grant.

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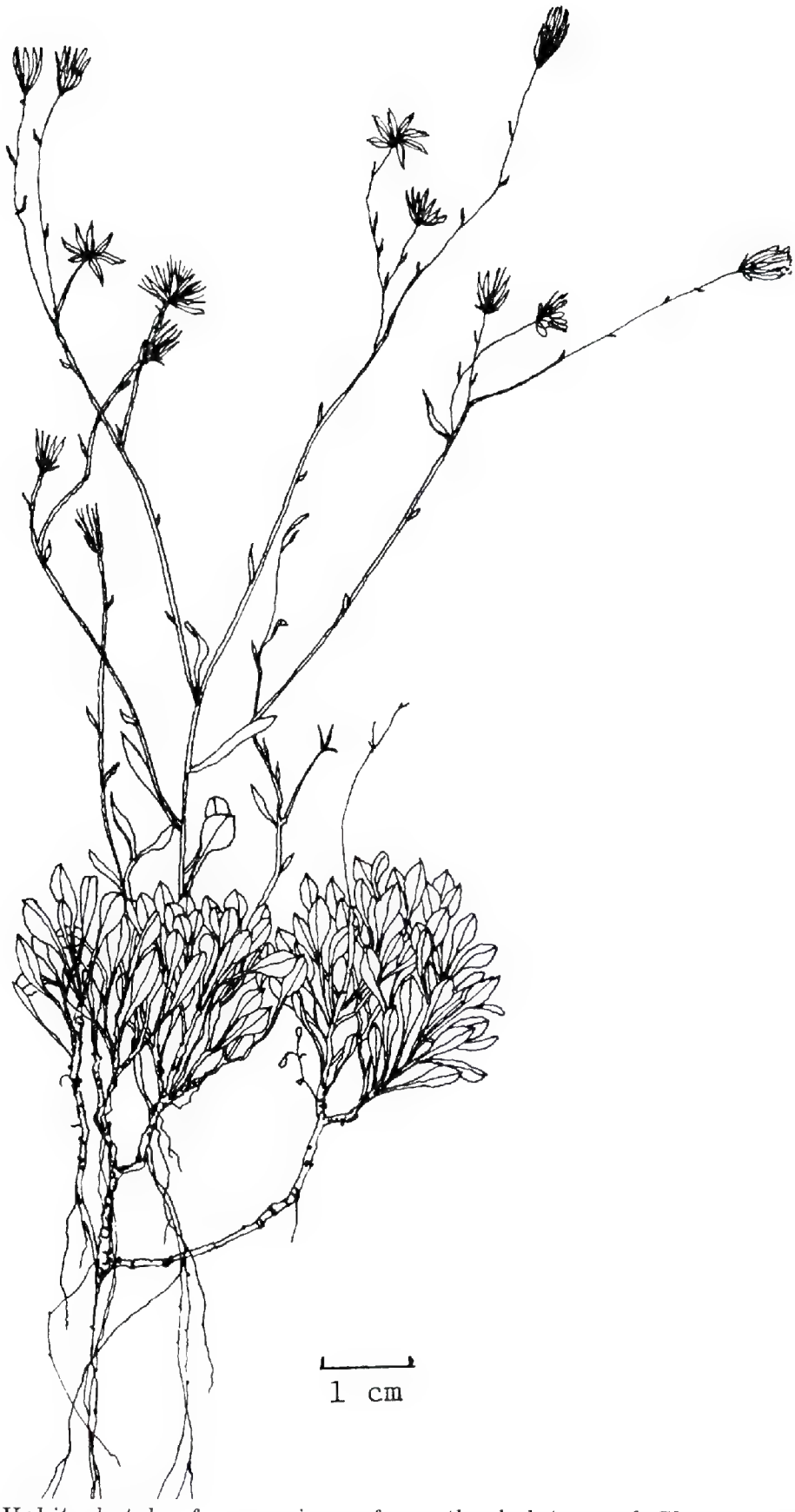

Fig. 1. Habit sketch of a specimen from the holotype of *Chaetopappa plomoensis*. xl.

RARE AND ENDANGERED AQUATIC VASCULAR PLANTS OF OHIO: AN ANNOTATED LIST OF THE IMPERILED SPECIES

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In Ohio and elsewhere, considerable concern is growing for the identity and protection of rare and endangered, or imperiled, species of plants. Man's impact on the environment has caused drastic changes that are now affecting organisms to the extent that these imperiled species are extinct or becoming extirpated, or their survival is endangered or threatened. Lists of rare and endangered species of plants for various states are now beginning to appear, for example, Arkansas (Tucker, 1974), Missouri (Holt, Keefe, Lewis, Pflieger, and Sullivan, 1974), New Jersey (Fairbrothers and Hough, 1973), and Texas (Anonymous, 1974), and a national report on the endangered and threatened plant species of the United States recently has been presented to the Congress of the United States (Ayensu and others, 1974). Although a list of Ohio's rare vascular plants was published 30 years ago (Jones, 1943), we here present a documented report on the imperiled species of aquatic vascular plants for Ohio, which to our knowledge is the first report for this group of plants for any given state. We are aware that reports of this type have certain limitations and will require revision as more information becomes available.

The indigenous or native aquatic vascular plants of Ohio are those plants that live and complete all or most of their life history in water or in a habitat that is wet throughout part of the year, such as a marsh, bog, or wet prairie. These plants generally grow submersed, floating, submersed with floating leaves, or emersed in shallow water. The inclusion of plants as aquatic and the information on their habitat comes from (1) available label data on herbarium specimens, (2) a knowledge of the biology of the species from our field studies in the state over the past eight years, and when necessary, (3) floristic literature for Ohio and adjacent states or from monographs of specific genera. Herbarium specimen records were obtained principally from the collections at The Ohio State University, Kent State University, The University of Cincinnati, and occasionally from Bowling Green State University and Miami University. Records for several groups studied by specialists (Ball for *Salix*, Mackenzie or Hermann for *Carex*, for exam-

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ple) were extracted from the card files of E. Lucy Braun at The Ohio State University Herbarium. We sometimes had great difficulty characterizing the habitat of those species which have not been located in the state for fifty years or more.

Ohio's imperiled species of aquatic vascular plants can be grouped into four categories based principally on (1) their distribution and abundance geographically, (2) the changes in population numbers through time, (3) the abundance and quality of existing suitable habitats in the state, and (4) the peculiarities of the biology of the species. The following categories are established and defined for use in the annotated list presented in Table 1.

EXTINCT. An extinct species is one that has been completely eliminated not only from Ohio, but from all other areas of its range within historic time. None of Ohio's aquatic vascular plants belong in this category.

EXTIRPATED (EX). An extirpated species is one based on records known from one or more counties 70-80 years ago, but which has not been reported in Ohio since. These species may be expected to survive in areas nearby to Ohio. In some cases our knowledge of site conditions and the species tolerances leads us to believe they may not exist in Ohio despite relatively recent records. Forty species are considered to be extirpated in Ohio.

ENDANGERED (EN). An endangered species is one based on records known from one or more counties 70-80 years ago, but which has been recorded in Ohio from only one or two counties since 1950. These species are in immediate jeopardy in Ohio and could readily become extirpated through destruction or environmental changes of a few critical sites. A few species without recent records have been considered as endangered because we believe they are probably present in unstudied existing suitable sites. Fifty-four species are considered to be endangered in Ohio.

THREATENED (TH). A threatened species is one known from older records and has recently been recorded in Ohio from three to no more than seven counties since 1950. These species are believed to have continued to survive at population levels comparable to their previous abundance, but they could become endangered or extirpated if drastic environmental and habitat changes occur. Fifty-two species are placed in this category.

These 146 imperiled species of Ohio aquatic vascular plants, if not extirpated already, exist in such small population numbers that special attention should be given for their survival as a part of the state flora. We believe that the change in the number of populations through time illustrates the effects the environment has had on the survival of a species. The data for the species considered in Table 1 are presented to substantiate and explain their inclusion. The most appropriate time periods selected to show these changes in the number of populations for each species are (1) the number of counties with at least one population record before about 1900, (2) the number of counties with at least one population record since about 1950, (3) the year of the earliest known record, and (4) the year of the latest known record. A list of the counties where each species has been recorded

is also included (Table 1), and the number of imperiled species known for each county is stated in Table 2. The trends observed and recorded should be predictive if the data base is reasonably accurate and substantial, and if habitat destruction occurs at about the present pace. An alternative list of species tolerant of changes and increasing in population numbers could also be presented. Of the 146 imperiled species, eight have never been located in Ohio since 1900 and 30 additional ones have not been seen or reported in the past 25 years.

The habitats of Ohio's imperiled species of aquatic vascular plants are quite specialized and complex, such as bogs, fens, marshes, swamps and/or combinations of these with ponds, lakes, streams, and/or mudflats. In order to simplify and condense information on the habitat, we have listed one or two of the most characteristic kinds of habitats in which each one of these imperiled species may be expected to occur. The aquatic or wetland habitat types selected along with a note on their chief distinguishing feature are: pond or lake (quiet, open water), stream (flowing water), fen (calcareous substrate conditions), bog (acidic substrate conditions), marsh (dominated with herbaceous vegetation), swamp (dominated with woody vegetation), and mudflat (exposed soil conditions that were formerly covered with water earlier in the growing season).

Considerable changes in the aquatic vascular plant flora of particular sites (Stuckey, 1971; Judd & Taub, 1973; Lowden, 1969; Moore, 1973) and for the genus *Najas* (Wentz & Stuckey, 1971) have been documented in Ohio. Our data indicate that the aquatic habitats in northeastern Ohio and the marshes along the shoreline of Lake Erie in northwestern Ohio have the greatest diversity of aquatic vascular plants in the state. These areas also contain the largest number of imperiled species of aquatic vascular plants (Table 3). The glacial topography of northern Ohio contains most of the bog, fen, and lake flora of the state. The marsh, swamp, stream, and mudflat flora is as well or even more represented here as elsewhere. The northern portion of Ohio has been subjected to considerable agricultural development, including extensive drainage and channelization. The northeastern section is currently undergoing rapid urbanization with a severe impact on the bog, pond, and lake flora from residential and industrial development. This impact has been particularly significant in the Cleveland-Akron-Canton metropolitan areas in the counties of Portage, Summit, Stark, Lake, and Geauga. The counties bordering Lake Erie in northwestern Ohio (Erie, Lucas, and Ottawa) have been severely affected by shoreline development which has disturbed the flora of the marshes, swamps, and mudflats. It is fortunate that these areas of the state that are now currently most severely affected by habitat degradation were centers of field botanical research 70-80 years ago before such changes became apparent. The information available from the beginning of the century has, therefore, been invaluable for documenting the depletion of the aquatic vascular plant flora. These trends are clearly evident, and, therefore, we believe in a strong program

for further acquisition and protection of Ohio's aquatic vascular plants and their habitats in wetland sites.

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Table 1. Annotated Checklist of Imperiled Aquatic Vascular Plants Indigenous in Ohio.

Imperiled Status	Name of Plant and Habitat	Total Number of Counties	Number of Counties With Records Before ca. 1900	Number of Counties With Records Since ca. 1950	Year of Earliest Known Record	Year of Latest Known Record	List of Counties With Records‡
	ISOETACEAE						
EX	Isoetes braunii Dur. Lake. Quillwort	1	0	0	1913	1935	67
EN	Isoetes engelmannii A. Br. Pond & Lake. Quillwort	4	1	1	1838	1973	11*, 12†, 50, 67
	SPARGANIACEAE						
TH	Sparganium androcladum (Engelm.) Morong Marsh. Bur-reed	6	1	4	1894	1962	3, 8†, 22*, 50†, 67†, 77†
EN	Sparganium chlorocarpum Rydb. Bog. Bur-reed	3	1	2	1892	1969	11†, 25*, 86†
	POTAMOGETONACEAE						
EN	Potamogeton filiformis Pers. Lake. Filiform Pondweed	1	0	1	1939	1970	62†

‡ The numbers refer to the counties as listed in Table 2. An asterisk after the number indicates a record previous to 1900; a dagger after the number indicates a record since 1950.

EX	Potamogeton friesii Rupr. Lake. Pondweed	3	2	0	1895	1901	22*, 62*, 77
EN	Potamogeton gramineus L. Pond & Stream. Pondweed	6	4	2	1888	1970	22*, 26†, 48†, 62*, 76*, 85*
EX	Potamogeton hillii Morong Pond & Stream. Pondweed	2	1	0	1877	1913	4*, 67
EX	Potamogeton perfoliatus L. Lake. Pondweed	1	1	0	1898	1898	62*
EN	Potamogeton praelongus Wulfen. Lake. White-stem Pondweed	5	1	1	1898	1969	4, 22, 62*, 76, 86†
EN	Potamogeton pulcher Tuckerm. Pond. Spotted Pondweed	6	3	1	1838	1970	4, 11*, 12*, 25, 40†, 85*
EN	Potamogeton richardsonii (Ar. Benn.) Rydb. Lake. Red-head pondweed	8	5	2	1835	1970	4, 10†, 16*, 22*, 43, 62*†, 67*, 77*
EN	Potamogeton robbinsii Oakes Lake. Pondweed	3	2	2	1894	1966	22*, 67†, 77*†
TH	Potamogeton spirillus Tuckerm. Pond. Pondweed	6	2	4	189-	1971	4*, 28*, 47†, 50†, 67†, 78†
EX	Potamogeton strictifolius Ar. Benn. Lake. Pondweed	1	1	0	1895	1898	22*
EN	Potamogeton tennesseensis Fern. Pond & Stream. Pondweed	3	0	2	1932	1967	15†, 40, 82†
EX	Potamogeton vaseyi Robbins Lake. Pondweed	3	0	0	1900	1935	4, 67, 78
TH	Potamogeton zosteriformis Fern. Lake. Flat-stem Pondweed	10	6	4	1835	1970	11†, 22*, 28, 45*, 46*†, 62*†, 64*, 67†, 76*, 77
	NAJADACEAE						
EX	Najas gracillima (A.Br.) Magnus Lake. Naiad	3	2	0	1898	1918	62*, 67, 85*
	JUNCAGINACEAE						
TH	Triglochin maritimum L. Fen. Arrow-grass	6	4	3	1835	1972	11*†, 12*, 43, 46†, 76*†, 77*
TH	Triglochin palustre L. Fen. Arrow-grass	6	1	3	1840	1965	11†, 22*, 49, 71, 72†, 76†

EN	Scheuchzeria palustris L. Bog.	7	3	1	1840	1973	3, 4, 23, 28*, 45*†, 47*, 67
	ALISMATACEAE						
TH	Echinodorus rostratus (Nutt.) Engelm. Mudflat. Bur-head	4	0	2	1905	1973	31, 65†, 66†, 71
TH	Sagittaria australis (J.G. Sm.) Small Mudflat. Arrowhead	10	3	6	1875	1972	1†, 6*, 7†, 12*, 13*, 27†, 36†, 40†, 53, 66†
EN	Sagittaria cuneata Sheldon Mudflat. Arrowhead	6	2	2	1894	1972	6, 22†, 40, 45, 62*†, 85*
EX	Sagittaria graminea Michx. Pond. Grass-leaf Arrowhead	4	2	1	1838	1951	11*, 18*, 48, 88†
TH	Sagittaria latifolia Willd. var. pubescens (Muhl.) J.G. Sm. Marsh. Common Arrowhead	3	0	3	1961	1967	15†, 34†, 41†
	GRAMINEAE						
TH	Calamagrostis inexpansa A. Gray Fen. Northern Reed Grass	3	0	3	1946	1967	22†, 48†, 71†
EN	Glyceria acutiflora Torr. Swamp. Manna Grass	3	0	2	1842	1971	38†, 45, 59†
EX	Glyceria borealis (Nash) Batchelder Pond. Northern Manna Grass	1	0	0	1925	1925	48
TH	Glyceria grandis S. Wats. Bog. Tall Manna Grass	7	1	7	1842	1969	4†, 15†, 28†, 67†, 74†, 76*†, 85†
TH	Glyceria melicaria (Michx.) F.T. Hubbard Swamp. Manna Grass	9	4	4	1889	1961	4*, 18*, 23, 28†, 40, 43*, 67†, 77*†, 78†
TH	Glyceria pallida (Torr.) Trin. Pond. Manna Grass	9	1	6	1840	1971	18†, 28†, 38†, 40†, 62, 67†, 76*, 77†, 78†, 79
EN	Zizania aquatica L. Marsh. Annual Wild Rice	15	7	3	1833	1972	4, 12, 22*, 37*, 43, 45*, 47, 48*, 57*, 62*†, 64*, 65†, 76, 77, 79†
	CYPERACEAE						
EX	Carex alata Torr. Bog & Marsh. Sedge	5	5	0	1887	1899	18*, 43*, 76*, 77*, 85*
EX	Carex aquatilis Wahl. Marsh. Sedge	7	7	0	1879	1939	6*, 22*, 43*, 46*, 47*, 48*, 62*

EN	Carex atherodes Spreng. Bog & Fen. Sedge	4	2	2	1897	1972	19†, 22*, 62†, 85*
EN	Carex aurea Nutt. Fen & Bog. Sedge	4	2	1	1898	1970	4*, 22*, 48, 77†
EX	Carex baileyi Britt. Marsh. Sedge	1	0	0	1934	1934	40
EX	Carex bebbii (Bailey) Fern. Bog. Sedge	2	1	0	1893	1935	47*, 76
EX	Carex brunnescens (Pers.) Poir. Bog & Swamp. Sedge	3	1	0	1871	1915	43*, 46, 78
EX	Carex cephalantha (Bailey) Bickn. Bog. Sedge	5	3	0	1883	1913	28, 43*, 47*, 67*, 76
Ex	Carex crus-corvi Shuttlew. Fen. Sedge	5	4	0	1840	1935	6*, 11*, 20*, 71, 87*
TH	Carex cryptolepis Mack. Bog & Fen. Sedge	6	2	4	1871	1971	1†, 4, 43*, 48†, 67†, 76*†
EX	Carex decomposita Muhl. Bog. Sedge	3	3	0	1838	1910	25*, 31*, 45*
EX	Carex diandra Schrank Bog. Sedge	8	5	0	1840	1935	22*, 25, 43*, 45*, 47*, 67, 76, 77*
EN	Carex flava L. Fen. Sedge	1	1	1	1840	1966	11*†
EX	Carex haydenii Dew. Fen & Marsh. Sedge	4	2	0	1894	1922	22*, 47*, 67, 78
EN	Carex howei Mack. Bog. Sedge	10	5	1	1892	1958	28†, 40, 43, 45*, 47*, 64, 67, 76*, 77*, 85*
EN	Carex interior Bailey Fen & Bog. Sedge	8	3	2	1886	1960	15†, 18†, 22*, 31, 40, 43*, 47*, 71
EX	Carex lasiocarpa Ehrh. Bog. Sedge	6	4	0	1889	1933	45*, 47*, 70, 76*, 77*, 85
EX	Carex limosa L. Bog. Sedge	5	2	0	1842	1945	3, 4*, 23, 45, 85*
EN	Carex oligosperma Michx. Bog. Sedge	2	1	1	1898	1968	20*, 67†
EX	Carex projecta Mack. Bog. Sedge	2	2	0	1894	1912	43*, 47*
EX	Carex pseudo-cyperus L. Bog. Sedge	2	2	0	1890	1922	22*, 45*
EX	Carex retrorsa Schwein. Marsh. Sedge	1	1	0	189-	189-	48*
EX	Carex sartwellii Dew. Fen. Sedge	3	1	1	1893	1934	22*, 48†, 71
EN	Carex sterilis Willd. Fen. Sedge	4	2	1	1840	1965	11*†, 22*, 49, 76
EN	Carex straminea Willd. Marsh. Sedge	2	0	2	1935	1963	37†, 40†

EX	Carex suberecta (Olney) Britt. Marsh. Sedge	9	3	2	1898	1963	6*, 11*, 12†, 23, 25*, 29†, 31, 36, 71
EN	Carex trisperma Dew. Bog. Sedge	9	6	0	1871	1938	3, 4, 28*, 43*, 47*, 67*, 77*, 78, 86*
TH	Carex viridula Michx. Fen. Sedge	4	2	3	1893	1972	11*, 22*†, 62†, 77†
TH	Cladium mariscoides (Muhl.) Torr. Fen. Twig-Rush	6	2	4	1893	1969	11*†, 22*†, 28, 48†, 67, 88†
TH	Cyperus diandrus Torr. Mudflat. Umbrella Sedge	6	1	4	1898	1969	15†, 20*, 22†, 47, 48†, 62†
TH	Cyperus engelmannii Steud. Mudflat. Umbrella Sedge	9	3	6	1897	1971	4, 6*†, 22†, 45†, 46*†, 48†, 62†, 76, 85*
TH	Eleocharis compressa Sulliv. Fen. Flat-stemmed Spike-rush	10	5	7	1840	1969	1†, 22*†, 26*, 43*, 48†, 49*, 51†, 62*†, 67†, 71, 76†
TH	Eleocharis elliptica Kunth Fen. Spike-rush	7	3	4	1892	1969	7, 22*†, 47*, 48*†, 62†, 66, 87†
TH	Eleocharis intermedia Schultes Mud-flat. Matted Spike-rush	9	2	7	1840	1974	15†, 20†, 23, 25*, 29†, 45†, 48†, 62*†, 86†
EN	Eleocharis olivacea Torr. Bog & Mudflat. Olivaceous Spike-rush	5	2	3	1894	1970	11†, 18*, 62†, 77*, 86†
EN	Eleocharis pauciflora (Lightf.) Link Fen. Spike-rush	3	0	1	1929	1967	11, 71, 86†
TH	Eleocharis quadrangulata (Michx.) R. & S. Marsh. Four-angled Spike-rush	7	1	4	1891	1973	1†, 3, 8†, 40†, 44†, 67, 77*
TH	Eleocharis rostellata Torr. Fen. Spike-rush	9	2	8	1892	1973	11*†, 15†, 22†, 38†, 46*†, 55, 67†, 76†, 77†
TH	Eriophorum virginicum L. Bog. Tawny Cotton-grass	11	7	3	1887	1973	3, 4*, 20*, 28*, 39, 45*†, 47*, 67*†, 70, 76†, 85*
TH	Eriophorum viridi-carinatum (Engelm.) Fern. Bog. Cotton-grass, Bog-cotton	10	5	5	1884	1969	4, 11†, 18*†, 22*, 28†, 43*, 45*, 67†, 76, 77*†
EN	Hemicarpha micrantha (Vahl) Pax Mudflat.	5	0	2	1928	1967	4, 40, 48†, 65, 86†
TH	Rhynchospora alba (L.) Vahl Fen. White Beak-rush	14	7	4	1840	1971	4, 11*†, 22*, 28*, 38†, 39, 40, 45*, 47*, 67†, 70, 76, 77*†, 85*

EX	Rhynchospora globularis (Chapm.) Small Fen. Beak-rush	3	1	0	1897	1946	22*, 48, 71
EN	Scirpus expansus Fern. Marsh. Bulrush	5	2	2	1898	1973	38†, 42†, 62*, 70*, 85
TH	Scirpus pedicellatus Fern. Bog. Bulrush	9	2	3	1887	1954	6*, 18, 43*, 47, 51†, 65†, 77†, 78, 85
TH	Scirpus purshianus Fern. Mudflat. Bulrush	8	3	3	1885	1973	14†, 40†, 43*, 62*, 65, 66, 77*, 82†
EN	Scirpus smithii Gray Mudflat. Bulrush	1	1	1	1895	1970	62*†
EX	Scirpus torreyi Olney Marsh. Bulrush	3	3	0	1889	1896	22*, 43*, 62*
EN	Scleria pauciflora Willd. Fen. Nut-rush	6	1	1	1897	1960	1†, 22*, 40, 48, 66, 71
TH	Scleria verticillata Willd. Fen. Nut-rush	9	3	5	1840	1969	11*†, 12, 22*†, 24, 25*, 29†, 65, 67†, 71†
	ARACEAE						
TH	Calla palustris L. Bog. Wild Calla	8	6	5	1837	1971	4*†, 18†, 28†, 39*, 67*†, 76*†, 77*, 78*
	LEMNACEAE						
EN	Lemna valdiviana Phillipi Pond. Pale Duckweed	2	0	1	1901	1958	13†, 43
TH	Wolffia papulifera C.H. Thompson Pond. Pointed Wolffia	4	0	3	1932	1973	40, 47†, 67†, 83†
EX	Wolffiella floridana (J.D. Sm.) C.H. Thompson Pond. Star Wolffiella	5	0	0	1906	1930	23, 45, 64, 67, 77
	XYRIDACEAE						
EX	Xyris difformis Chapman Bog. Yellow-eyed-Grass	2	2	0	1890	1891	28*, 67*
EN	Xyris torta Sm. Mudflat. Yellow-eyed-Grass	5	1	2	1892	1961	27†, 40, 48†, 73, 87*
	ERIOCAULACEAE						
EX	Eriocaulon septangulare With. Mudflat. White-buttons, Duckgrass	2	0	0	1913	1915	67, 77
	PONTEDERIACEAE						
EX	Heteranthera reniformis R. & P. Mudflat. Mud-plantain	2	2	0	1837	1849	31*, 57*
	JUNCACEAE						
TH	Juncus alpinus Vill. Fen. Rush	5	3	2	1840	1972	18*, 22†, 43*, 48, 62*†

EN	Juncus greenei Oakes & Tuckerm. Mudflat. Rush	1	0	1	1927	1971	48†
EN	Juncus interior Wieg. Marsh. Rush	2	0	1	1933	1966	49, 72†
TH	Juncus subcaudatus (Engelm.) Coville & Blake Marsh. Rush	3	0	3	1950	1967	37†, 65†, 71†
	LILIACEAE						
TH	Tofieldia glutinosa (Michx.) Pers. Fen. False Asphodel	8	4	5	1835	1973	11*†, 12*, 46†, 48, 57*, 67†, 76*†, 77†
	IRIDACEAE						
TH	Iris brevicaulis Raf. Marsh. Leafy Blue Flag	13	2	3	1837	1965	6*, 19†, 25, 31*, 35, 36, 51, 62, 65, 71, 80, 81†, 83†
	ORCHIDACEAE						
EN	Arethusa bulbosa L. Bog. Arethusa; Dragon's mouth	3	3	2	1891	1960	45*†, 47*, 67*†
EN	Cypripedium candidum Willd. Fen. White Lady's-slipper	8	4	2	1836	1968	11*, 12*, 22*†, 48, 57*, 67†, 78, 88
EX	Habenaria blephariglottis (Willd.) Hook. Bog. White Fringed Orchid	5	3	0	1835	1937	4*, 28, 48, 67*, 77*
EX	Habenaria ciliaris (L.) R.Br. Bog. Orange or Yellow Fringed Orchid	6	2	0	1893	1944	1, 26*, 43, 48*, 71, 73
EX	Habenaria leucophaea (Nutt.) A. Gray Bog. Prairie White Fringed Orchid	5	4	0	1838	1916	6*, 11*, 22, 25*, 57*
TH	Spiranthes lucida (H.H. Eat.) Ames Fen & Marsh. Shining Ladies' Tresses	13	6	3	1887	1961	1†, 11, 13*, 18*, 29*, 43*, 48, 52*, 66, 67*, 71†, 77†, 78
EN	Spiranthes romanzoffiana Cham. Fen. Hooded Ladies' Tresses	6	4	2	1882	1960	4*†, 22*, 28, 43*, 52*, 76†
	SALICACEAE						
TH	Salix bebbiana Sarg. Bog & Fen. Long-beaked Willow	12	10	1	1892	1974	4*, 22*, 26*, 35†, 39, 43*, 47*, 48*, 62*, 77*, 87*, 88*
TH	Salix candida Fluegge Bog & Fen. Sage-leaf Willow	8	4	4	1898	1967	15†, 22*†, 26*, 67†, 76*, 77, 86†, 88*

TH	Salix pedicellaris Pursh Bog & Fen. Bog Willow	12	5	2	1891	1969	3, 4, 11, 28†, 39, 45*, 64*, 67*, 76, 77†, 85*, 86*
TH	Salix petiolaris J.E. Smith Bog & Fen. Willow	8	5	3	1879	1969	6*, 15†, 22*, 26*, 48*, 67†, 77†, 86, 87*
TH	Salix serissima (Bailey) Fern. Bog & Fen. Autumn Willow	5	1	4	1899	1969	15†, 67†, 76†, 77†, 86*
EN	× Salix subsericea (Anderss.) Schneid. Bog & Fen. Willow.	4	3	1	1899	1969	4*, 11*, 47*, 77†
	MYRICACEAE						
EN	Myrica pensylvanica Loisel. Bog. Bayberry	3	1	1	189-	1961	4, 67†, 77*
	BETULACEAE						
TH	Betula pumila L. Fen. Low Birch	7	4	3	1835	1972	11*†, 12, 67, 76*, 77*, 86†, 88*†
	URTICACEAE						
TH	Pilea fontana (Lunell) Rydb. Marsh. Clearweed	7	0	7	1900	1974	15†, 42†, 67†, 72†, 76†, 79†, 86†
	POLYGONACEAE						
EN	Polygonum pensylvanicum L. var. eglandulosum Myers Mudflat. Smartweed	2	0	2	1940	1975	22†, 62†
	CERATOPHYLLACEAE						
TH	Ceratophyllum echinatum Gray Pond. Hornwort, Coontail	9	0	5	1913	1974	4†, 10†, 25, 39†, 40, 47†, 62†, 67, 70
	NYMPHAEACEAE						
EN	Nuphar variegatum Engelm. Pond. Yellow Water-lily, Spatter-dock	3	1	2	1894	1970	22*, 48†, 62†
	RANUNCULACEAE						
EN	Ranunculus pusillus Poir. Marsh & Mudflat. Water Crowfoot	4	0	1	1922	1950	4, 13, 27†, 71
	CRUCIFERAE						
EX	Armoracia aquatica (Eat.) Wieg. Stream. Lake Cress	6	4	0	1889	1936	16*, 45*, 48, 49*, 64*, 65

TH	Rorippa sessiliflora (Nutt.) Hitchc. Mudflat. Yellow-cress	7	1	4	1878	1970	1†, 31*, 54†, 62†, 65†, 66, 71
	SARRACINEACEAE						
TH	Sarracenia purpurea L. Bog. Pitcher-plant	14	9	4	1835	1971	3, 4*, 20*, 28*†, 39, 45†, 46*, 47*, 67†, 70, 76*†, 77*, 85*, 86*
	DROSERACEAE						
EN	Drosera intermedia Hayne Bog. Sundew	4	1	1	1899	1967	28†, 43, 48, 85*
	ROSACEAE						
TH	Potentilla palustris (L.) Scop. Bog. Marsh Cinquefoil	14	8	3	1838	1960	3, 4*, 11*, 18†, 28†, 38, 39, 45*, 47*, 67*, 76*†, 77*, 78, 85*
	CALLITRICHACEAE						
TH	Callitriche terrestris Raf. emend Torr. Mudflat. Water Starwort	10	1	3	1890	1969	13*, 21, 25, 31, 37, 41†, 60, 67†, 71, 83†
TH	Callitriche verna L. Pond & Stream. Starwort	7	3	2	1888	1971	4, 10†, 18*, 25, 28*, 47*, 78†
	RHAMNACEAE						
TH	Rhamnus alnifolia L'Her. Fen. Buckthorn	10	3	7	1840	1972	4†, 11*†, 15†, 18*, 28, 43*, 48†, 67†, 76†, 77†
	HYPERICACEAE						
TH	Hypericum kalmianum L. Fen. St. John's-wort	6	4	3	1891	1960	22*†, 26†, 48*, 62*, 76†, 77*
	HALORAGACEAE						
EN	Myriophyllum exalbescens Fern. Pond & Lake. Water-milfoil	12	10	4	1891	1972	6*, 18*, 22*, 23*, 38†, 45*, 46*, 62*†, 64*, 67*†, 76†, 86*
EN	Myriophyllum heterophyllum Michx. Pond & Stream. Water-milfoil	7	1	2	1835	1973	4, 11, 36, 45*, 46†, 78, 80†
EX	Myriophyllum verticillatum L. Lake. Water-milfoil	2	2	0	1838	1840	11*, 67*
	UMBELLIFERAE						
TH	Hydrocotyle americana L. Swamp. Water-pennywort	12	6	6	1885	1971	15†, 18*, 28†, 38†, 43*, 45†, 67†, 71, 76*†, 77*, 79*, 85*
EN	Hydrocotyle umbellata L. Pond. Water-pennywort	4	2	2	1891	1971	4, 28†, 67*†, 76*

	ERICACEAE						
EX	Andromeda glaucophylla Link Bog. Bog-rosemary	5	2	0	1878	1929	4, 28*, 76, 77, 85*
TH	Chamaedaphne calyculata (L.) Moench Bog. Leather-leaf	11	6	4	1871	1970	4, 18†, 20*, 22, 28*†, 45, 67†, 76*†, 77*, 85*, 86*
EN	Vaccinium oxycoccos L. Bog. Small cranberry	8	4	2	1889	1961	3, 28†, 45*, 47*, 67†, 76, 77*, 85*
	PRIMULACEAE						
EN	Hottonia inflata Ell. Pond. Featherfoil	2	1	1	1891	1974	4*, 73†
	GENTIANACEAE						
EN	Menyanthes trifoliata L. Bog. Buckbean	12	5	1	1835	1970	3, 4, 11*, 25, 28, 39, 43*, 45*†, 67, 76, 77*, 85*
	SCROPHULARIACEAE						
EN	Gratiola virginiana L. Mudflat. Hedge-hyssop	4	1	2	1897	1973	13, 22*, 27†, 40†
EN	Gratiola viscidula Pennell Mudflat. Hedge-hyssop	3	0	3	1932	1974	27†, 40†, 73†
	LENTIBULARIACEAE						
EN	Utricularia cornuta Michx. Fen & Bog. Bladderwort	3	3	1	1839	1964	11*†, 77*, 85*
EN	Utricularia intermedia Hayne Fen & Bog. Bladderwort	5	2	3	1893	1972	11†, 43*, 67†, 76†, 85*
EN	Utricularia minor L. Fen & Bog. Bladderwort	4	1	2	1893	1972	11*†, 15†, 45, 67
	PLANTAGINACEAE						
EN	Plantago cordata Lam. Stream. Plantain	7	3	1	1835	1973	1†, 6*, 25*, 46, 47*, 48, 49
	CAPRIFOLIACEAE						
EX	Linnaea borealis Gronov. Bog. Twinflower	2	1	0	1900	1924	76*, 77
	VALERIANACEAE						
EN	Valeriana ciliata Torr. & Gray Fen. Valerian	1	1	1	1837	1964	11*†
	COMPOSITAE						
EX	Megalodonta beckii (Torr.) Greene Lake. Bur-marigold	7	5	1	1860	1966	4, 22*, 52*, 62*, 67†, 76*, 77*

Table 2. Numbered List of Ohio Counties With Numbers of Imperiled Species in Each County.

Number	County	Number of Imperiled Species	Number	County	Number of Imperiled Species
1	Adams	8	45	Licking	27
2	Allen	0	46	Logan	10
3	Ashland	9	47	Lorain	27
4	Ashtabula	37	48	Lucas	33
5	Athens	0	49	Madison	5
6	Auglaize	12	50	Mahoning	3
7	Belmont	2	51	Marion	3
8	Brown	2	52	Medina	3
9	Butler	0	53	Meigs	1
10	Carroll	2	54	Mercer	0
11	Champaign	35	55	Miami	1
12	Clark	10	56	Monroe	0
13	Clermont	5	57	Montgomery	5
14	Clinton	1	58	Morgan	1
15	Columbiana	14	59	Morrow	1
16	Coshocton	1	60	Muskingum	0
17	Crawford	0	61	Noble	0
18	Cuyahoga	17	62	Ottawa	31
19	Darke	2	63	Paulding	0
20	Defiance	6	64	Perry	6
21	Delaware	1	65	Pickaway	8
22	Erie	47	66	Pike	6
23	Fairfield	7	67	Portage	60
24	Fayette	1	68	Preble	0
25	Franklin	14	69	Putnam	0
26	Fulton	7	70	Richland	5
27	Gallia	4	71	Ross	17
28	Geauga	28	72	Sandusky	3
29	Greene	4	73	Scioto	4
30	Guernsey	0	74	Seneca	1
31	Hamilton	6	75	Shelby	0
32	Hancock	0	76	Stark	43
33	Hardin	0	77	Summit	49
34	Harrison	1	78	Trumbull	14
35	Henry	2	79	Tuscarawas	4
36	Highland	4	80	Union	2
37	Hocking	4	81	Van Wert	1
38	Holmes	8	82	Vinton	2
39	Huron	8	83	Warren	3
40	Jackson	20	84	Washington	0
41	Jefferson	2	85	Wayne	25
42	Knox	2	86	Williams	15
43	Lake	30	87	Wood	5
44	Lawrence	0	88	Wyandot	6

Table 3. Counties with the Largest Numbers of Imperiled Species.

Rank	County	Number of Imperiled Species	Portion of the State
1	Portage	60	Northeastern
2	Summit	49	Northeastern
3	Erie	47	Northwestern
4	Stark	43	Northeastern
5	Ashtabula	37	Northeastern
6	Champaign	35	West-central
7	Lucas	33	Northwestern
8	Ottawa	31	Northwestern
9	Lake	30	Northeastern
10	Geauga	28	Northeastern
11	Licking	27	Central
12	Lorain	27	Northeastern

APPENDIX

Those species of very limited occurrence in the state which we consider as non-indigenous (non-native) to the flora of Ohio are enumerated in part 1 of the appendix. In certain situations, our concepts of which species are non-indigenous differ somewhat with previously published statements, hence the need for this separate list. For those individuals who consider some of these species in this list as indigenous (native), they would have to be placed in table 1. In part 2 of the appendix, we list all of those species known to us which have been reported for Ohio as having a very limited occurrence in the state, but which have been eliminated from consideration because of the reasons that are stated for each species.

Appendix Part 1. Annotated List of Rare Aquatic Plants Non-Indigenous in Ohio.

Name of Plant and Habitat	Total Number of Counties	Number of Counties with Records Before ca. 1900	Number of Counties with Records Since ca. 1950	Year of Earliest Known Record	Year of Latest Known Record	List of Counties With Records‡
MARSILEACEAE						
Marsilea quadrifolia L. Pond. Water Clover	2	0	1	1941	1970	23†, 25

SALVINIACEAE						
Azolla caroliniana Willd. Pond. Water-velvet	9	2	5	1901	1974	22†, 25, 31, 43*, 48*†, 62†, 67, 76†, 79†
NAJADACEAE						
Najas marina L. Pond. Naiad	2	0	2	1949	1971	22†, 62†
GRAMINEAE						
Calamagrostis cinnoides (Muhl.) Bart. Marsh. Reed Bentgrass	1	1	0	18—	18—	45*
CYPERACEAE						
Eleocharis caribaea (Rottb.) S.F. Blake Mudflat. Spike-rush	1	0	1	1967	1970	62†
Eleocharis wolfii Gray Fen. Spike-rush	1	0	0	1945	1945	71
Eriophorum gracile W.D.J. Koch Bog. Cotton-grass	1	0	0	1931	1931	25
Scirpus saximontanus Fern. Mudflat. Bulrush	1	0	1	1936	1973	65†
JUNCACEAE						
Juncus diffusissimus Buckl. Marsh. Rush	4	0	4	1954	1972	40†, 44†, 66†, 73†
NYMPHAEACEAE						
Cabomba caroliniana Gray Stream. Fanwort	3	0	2	1933	1971	43, 77†, 78†
ELATINACEAE						
Elatine brachysperma Gray Mudflat. Waterwort	1	0	1	1935	1935	65†
LYTHRACEAE						
Lythrum hyssopifolia L. Mudflat. Loosestrife	1	0	1	1935	1955	65†
ONAGRACEAE						
Ludwigia decurrens Walt. (Jussiaea decurrens (Walt.) DC.) Mudflat. Primrose-willow	4	0	4	1951	1974	1†, 8†, 27†, 44†
Ludwigia leptocarpa (Nutt.) Hara (Jussiaea leptocarpa Nutt.) Mudflat. Primrose-willow	2	0	2	1951	1973	1†, 8†
HALORAGACEAE						
Myriophyllum aquaticum (Vellozo) Verdc.	1	0	1	1949	1959	73†

(M. brasiliense Cambess.) Pond & Stream. Parrot's Feather						
UMBELLIFERAE						
Hydrocotyle ranunculoides L.f. Marsh. Water-pennywort	2	0	2	1959	1971	10†, 38†
PRIMULACEAE						
Centunculus minimus L. Mudflat. Chaffweed	2	0	0	1935	1935	40, 65
MENYANTHACEAE						
Nymphoides peltatum (Gmel.) Ktze. Stream. Floating-heart	1	0	0	1930	1930	4
COMPOSITAE						
Senecio glabellus Poir. Mudflat. Butterwort	2	0	1	1926	1974	62†, 68

Appendix Part 2. Species Excluded

Species	Locality	Reference	Reason for Exclusion
Hippuris vulgaris L.	Ohio	Muenscher (1944)	No specimen located
Lemna minima Phillipi	Paulding County	Hicks (1937), Braun (1967)	No specimen located
	Cuyahoga County	Walters (1950)	No specimen located
	Ohio	Muenscher (1944)	No specimen located
Lemna perpusilla Torr.	Mercer County	Hicks (1937)	Mercer County specimen not located; Knox County specimen is *L. minor*
	Knox and Mercer Counties	Braun (1967)	
Mayaca aubleti Michx.	Auglaize County	Gleason (1905)	Erroneously reported according to Gleason (1952, Vol. 1, p. 377)
	Ohio	Muenscher (1944)	No specimen located
Myriophyllum alterniflorum DC.	Ohio	Muenscher (1944)	No specimen located
Myriophyllum humile (Raf.) Morong	Ohio	Muenscher (1944)	No specimen located
Peplis diandra Nutt. (Didiplis	Lake County	Schaffner (1932), Jones (1943),	Specimen is *Callitriche*

diandra (Nutt.) Wood)		Blackwell (1970)	*heterophylla*
Podostemum ceratophyllum Michx.	Pickaway County	Althaus (1967)	Specimen is *Riccia fluitans*

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A NEW SPECIES OF *RHYNCHOSPORA* (CYPERACEAE) FROM SOUTHWESTERN GEORGIA

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In 1947, during his extensive floristic survey of southwestern Georgia, Dr. Robert Thorne (now at RSA) discovered in Baker County what appeared to him to be a new species of *Rhynchospora* (see Castanea 16: 35. 1951). Specimens from this collection, together with some other Cyperaceae, have been sent to me by Dr. Thorne for definitive study. The *Rhynchospora* is indeed a novelty, and is described as follows:

Rhynchospora **thornei** Kral, sp. nov.

Planta perennis glabra. Rhizoma squamulosa breve ramosissima implexa. Culmi plures caespitosi filiformes 10–15 cm alt., 0.2–0.3 mm lati, infime teretiusculi vel obtusanguli sursum trigoni, scabridiusculi. Folia culmo breviora filiformia 10–13 cm longa, laminis basibus planis superne trigonis vel canaliculatis scabridiusculis. Cymae 2–3 valde distantes perlaxi, anguste-turbinatae, simplices vel semicompositae, pauciramosae, paucispiculosae. Pedunculi filiformi scabridiusculi vel laevi. Spiculae lanceolato-ovoideae vel fusiformes acuminatae, 2.5–3.0 mm longae, 1–2–nucigerae. Squamae ovatae subscariosae ca. 1.5 mm longae, anguste-acutae, integrae vel minute erosae, breve mucronatae, lampro-aureo-ferrugineae. Setae 6 minute-antrorsae-scabrae subtiles usque ad ½–⅔ nuceis aequantes. Stamina 1–2, anthera ca. 0.2. mm longa. Achenium (cum tuberculo) ca. 1 mm longum subobovato-ellipticum, biconvexum, reticulatum, marginatum, cancellatum, cancellis verticalis rectangularis. Tuberculum breviconicum, acutum, ca. 0.15 mm longum.

Type. U.S.A. Georgia. Baker Co.: damp sand of Emory University Field Station Experimental Area near Mossy Pond, 23 June 1947, *Robert F. Thorne 4881*. Holotype RSA. Isotype VDB.

This species, still known only from the type locality, is named after its discoverer, whose extensive field work during the 1940's, particularly in southwestern Georgia, has contributed much to our present knowledge of the southeastern flora.

As the description indicates, *R. thornei* is a low, very slender-leaved and -culmed sedge superficially very much resembling either *R. pusilla* (*R. intermixta*) or *R. divergens*. Like them it has quite small spikelets, of similar coloration. However, it has a definite perianth of bristles and a smaller number of florets per spikelet and therefore belongs in the Section "Eurhyn-

SIDA 7(1): 42-50. 1977.

chospora" Griseb. rather than in the Section *Psilocarya* (Torr.) Clarke to which *R. pusilla* and *R. divergens* belong (see G. Kükenthal, Vorarbeiten zu einer Monographie der Rhynchosporideae, Botanische Jahrbücher 74: Heft 3, 1949 and subsequent numbers for treatment of these!). If the excellent key to series of Eurhynochospora done by S. Gale (1944) is applied to the problem, the new beak-rush is found to belong to series "Rariflorae" Gale. This series contains, in Gale's treatment, but 2 species, namely *R. rariflora* (Michx.) Ell. and *R. stenophylla* Chapm. The former is widespread in the southeastern United States, the Caribbean and Central America; the latter is rare and local from N.C. south into S.C. with disjunctions in northwest Florida and southern Alabama. While *R. thornei* is a lower, more slender plant than either of these, the vegetative characters agree rather well, particularly those of scape and leaf and those of the formation of dense mats through the close interweavings of short, scaly-rhizomatous offshoots.

However the case, there is wide divergence of opinion between Gale, Kükenthal and many other cyperologists when it comes to placement of species in sections or series of the subgenus "Diplostylae" Bentham, particularly when it is realized that almost all authors concentrate mainly on akene and perianth bristle characters. In light of this difficulty and because of my own inexperience with the genus on a broad scale, I shall present below a small treatment of those few North American *Rhynchospora* that most closely resemble the new species.

1. Perianth bristles present; plants forming mats of tufts by short, branching, scaly rhizomes; akene, including tubercle, 1 mm long or more.
   2. Akene and tubercle ca. 1 mm long; akene body distinctly margined; plants not more than 1.5 dm tall; spikelets not longer than 3 mm . . . . . 1. *R. thornei* Kral
   2. Akene and tubercle mostly 2–3 mm long; akene body not distinctly margined; plants rarely as low as 2 dm; spikelets 3.5–5.0 mm long.
      3. Perianth bristles rarely exceeding middle of akene body, never reaching to tubercle base; spikelets 3.5–4.5 mm long; tubercle short-triangular, ca. 0.3 mm high . . . . . 2. *R. rariflora* Ell.
      3. Perianth bristles mostly reaching at least the tubercle base; spikelets ca. 5 mm long; tubercle narrowly triangular-acuminate, 1.0–1.5 mm long . . . . . 3. *R. stenophylla* Chapm.
1. Perianth bristles absent; plants lacking short, branching scaly rhizomes; akene including tubercle not longer than 0.6 mm long.
   4. Akene body nearly smooth, finely reticulate . . . . . 4. *R. divergens* M. A. Curtis
   4. Akene body transversely rugose and finely vertically lined . . . . . 5. *R. pusilla* M. A. Curtis

1. RHYNCHOSPORA THORNEI Kral, Fig. 1.

The plant densely tufted, perennial, glabrous, forming mats by means of short, ascending, scaly-rhizomatous offshoots. Lowest leaves shortest, mostly sheath; longest leaves 10–13 cm long, 0.2–0.3 mm broad, with blades spreading-ascending, proximally flat, then grading upward from involute to semiterete or channelled, then trigonous except for the somewhat flattened

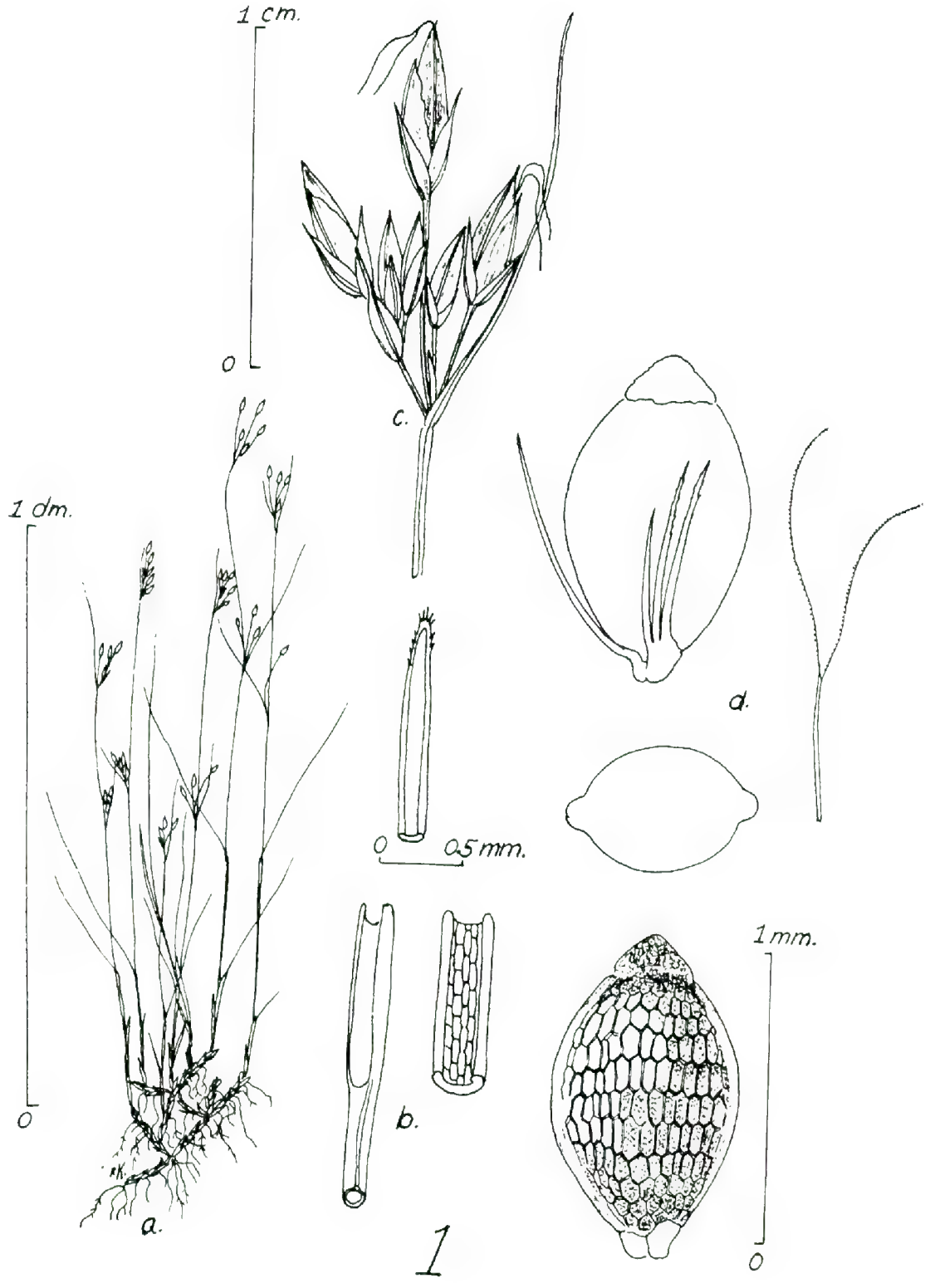

Figure 1. *Rhynchospora thornei.* a. Habit sketch. b. Inner surface of cauline leaf at sheath orifice, mid-blade, and apex. c. Inflorescence. d. Akene, showing perianth bristles, cross-section of body, and body with surface markings. From *Thorne 4881.*

narrow apex, there scabrous-edged. Culms mostly 10–15 cm long, somewhat flexuous, filiform, mostly 0.2–0.3 mm broad, proximally obtusangulate, multicostate, becoming mostly sharply trigonous distally. Cymes mostly 1–2, if 2, distant, each subtended by at least 1 foliaceous, setaceous bract, narrowly turbinate, open and with few spikelets, the peduncles few and of varying lengths, these simple or with 2 or 3 spikelets each. Spikelets lance-ovoid or fusiform, 2.5–3.0 mm long, acuminate, usually 2-flowered, each subtended by 2–3 lanceolate, barren bractlets shorter than the fertile scales. Fertile scales ovate, subscarious, ca. 1.5 mm long, acute, entire or slightly erose, 1-nerved and slightly keeled, the mid-nerve excurrent as a short mucro, the surfaces smooth, lustrous golden-brown. Perianth bristles 4–6, antrorsely minutely barbellate, the shortest vestigial, the longest shorter than the akene body. Stamens 1, (–2), the anthers ca. 0.2 mm long, short-linear. Akene (including tubercle) ca. 1 mm long, the body ellipsoidal, biconvex, a lustrous pale brown, produced along the edge into an evident though narrow, wirelike margin, the surface minutely but evidently cancellate, the cancellae narrowly to broadly rectangular, vertically oriented in wavy horizontal rows (more isodiametric and irregularly arranged proximally and distally!) and also transversely rugulose; tubercle short-conic, barely 0.15 mm long.

2. RHYNCHOSPORA RARIFLORA (Michx.) Ell., Sk. Bot. S. Car. & Ga. i., p. 58. 1816. Fig. 2.
Schoenus rariflorus Michx., Fl. Bor.-Am. I. 35. 1803.
Phaeocephalum rariflorum House, Am. Midl. Nat. 6. 202. 1902.

Perennial, glabrous, densely tufted from closely forking scaly compact rhizomes. Leaves linear-filiform, the lowest mostly sheathing, the longest with blades mostly 10–15 cm long, between 0.7 and 1.0 mm broad, proximally flattish, the backs with several raised nerves, often becoming strongly revolute upward and triangular, acute-angled and sulcate toward the apex, there with the margins finely scabrid. Culms (1.5–) 2.0–5.0 (–6.0) dm tall, wiry-filiform, rather weak, terete and multicostate proximally, distally with a strong sulcus below the nodes. Inflorescences mostly 2, distant, each cyme open, simple or compound the (usually) few spikelets divaricate-ascending on peduncles of various lengths, each prophyllate; lowermost cymes subtended by a foliaceous bract that is longer, the uppermost by a similar bract but this equalling or shorter, and each cyme if compound with smaller bracts subtending each cymule. Spikelets 3.5–4.5 mm long, narrowly ovoid or fusiform, acuminate, mostly with (–3) 2 fertile scales these subtended by 2–3 (–4) smaller, barren bracts. Fertile scales smooth, ovate to oblong, 2–3 mm long, obtuse to broadly acute, subentire, scarious, a rich golden-reddish-brown, the backs rounded, with 1 prominent medial nerve, this excurrent as a short mucro. Perianth bristles mostly 6, dark reddish-brown, upwardly scabrous, unequal, the longest rarely longer than mid-akene. Stamens usually 2, anthers ca. 2 mm long, narrowly linear. Akene with tubercle ca. 2 mm long, ellipsoidal to obovoid, biconvex to somewhat plano-convex (the side

facing inward often flattish), the body yellowish or reddish-brown, transversely wavy-rugose, with several irregular rows of vertically oriented, nearly linear, fine cancellae. Tubercle grayish-crustose, blunt-triangular, ca. 0.3 mm high, somewhat dorsiventrally flattened.

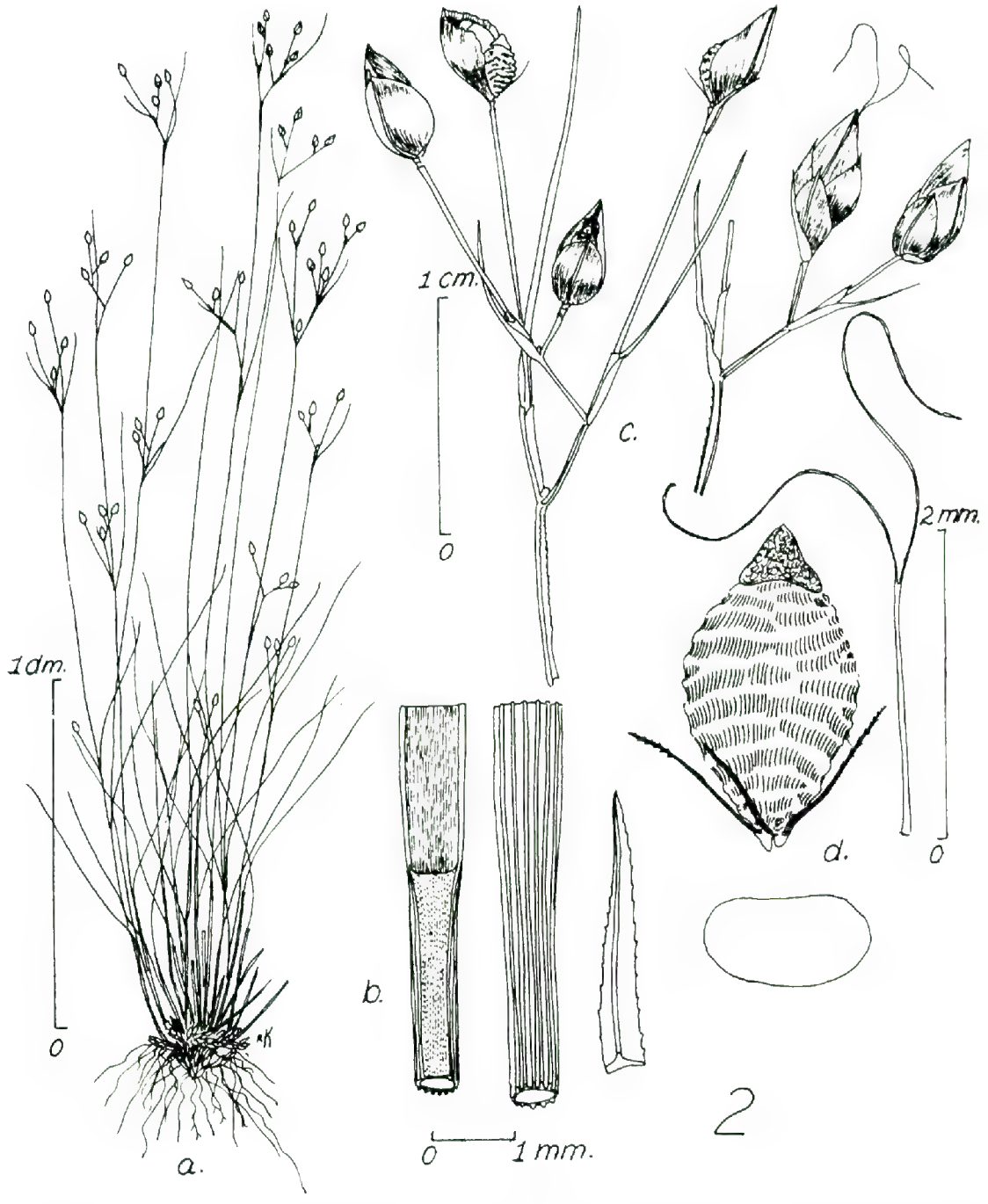

Figure 2. *Rhynchospora rariflora*. a. Habit sketch. b. Inner surface of leaf at sheath orifice; back of leaf at same level; leaf blade apex. c. Two views of inflorescence, that on left at fruiting stage, that on right showing a portion of a younger inflorescence (slightly enlarged above scale!). d. Akene and stylar apparatus, cross-section through body. From *Kral 24154*.

Moist to wet sands or sandy peats of low savanna, bogs, seeps, Coastal Plain from New Jersey and southeast Virginia southward into peninsular Florida and westward into Texas with isolated stations inland as far as northern Georgia and Middle Tennessee, scattered in Caribbean and Central America.

R. rariflora, together with the much more local *R. stenophylla* both tend to form small "sods" of densely caespitose tufts and thus in habit are very similar to *R. thornei*.

3. RHYNCHOSPORA STENOPHYLLA Chapm., Fl. S.U.S. p. 525. 1860.

Similar in almost all ways to *R. rariflora* but taller, the culms often from 6 to 9 dm tall. Spikelets narrower, more narrowly lanceolate in outline, longer, ca. 5 mm long, usually with but 1 fertile floret. Akene with tubercle longer; akene body ca. 1.5 mm long, narrowly biconvex, sculptured as in *R. rariflora*; tubercle ca. 1.5 mm long, narrowly triangular-acuminate, somewhat dorsiventrally flattened. Perianth bristles usually 6, unequal, antrorsely barbellate, arising from a lobed short-hairy basal joint and some nearly reaching or exceeding the tubercle tip.

In habitats similar to those of *R. rariflora* but with known range restricted to the eastern parts of the Carolinas, northwestern Florida and southern Alabama. Fig. 3.

4. RHYNCHOSPORA DIVERGENS Chapm. ex., M.A. Curtis, Amer. Journ. Sc., Ser. 2, 7, p. 409. 1849. Fig. 4.
R. divergens Chapm., Fl. S.U.S. p. 528. 1860.
Phaeocephalum divergens House, Am. Midl. Nat. 6, p. 201. 1920.

Perennial, glabrous, densely tufted through close-set, thick-based offshoots. Leaves linear-filiform, the lowest sheathing, the sheaths tubular, multicostate, scarious on side opposite the blade, the blades 5–15 cm long, 0.3–0.5 mm wide ascending or spreading, flat just above the sheath, upwardly becoming strongly involute, then channelled, then sharply trigonous toward the narrowly acute apex, there scabrous on the angles and on the slightly flattened tip. Culms linear-filiform, (1.5–) 2.0–5.0 (–6.0) dm tall, erect or spreading and arching from the clump, proximally terete, multicostate, upwardly becoming channelled below the sheaths on the side opposite the leaf blades. Inflorescences (1–) 2–3 (–4) narrowly to broadly turbinate, each subtended by a long-linear-filiform-bladed bract this exceeding the cyme. Cymes compound, paniculiform, the spikelets numerous, the peduncles scabrid, of varying length, a few primary peduncles simple, most zig-zag, with each node producing a lanceolate bract, a chaffy-tubular prophyll, as a short-stalked spikelet and a prolongation of the primary peduncle. Spikelets asymmetrically lance-ovoid or fusiform, ca. 3 mm long, acuminate, usually subtended by 2–3 lanceolate sterile scales shorter than the 4 or more fertile scales, the lowermost sterile scales abscising, then progressively the fertile abscising (akenes often persisting after) as the spikelet elongates, thus the spikelets producing several fruits but keeping their original length and

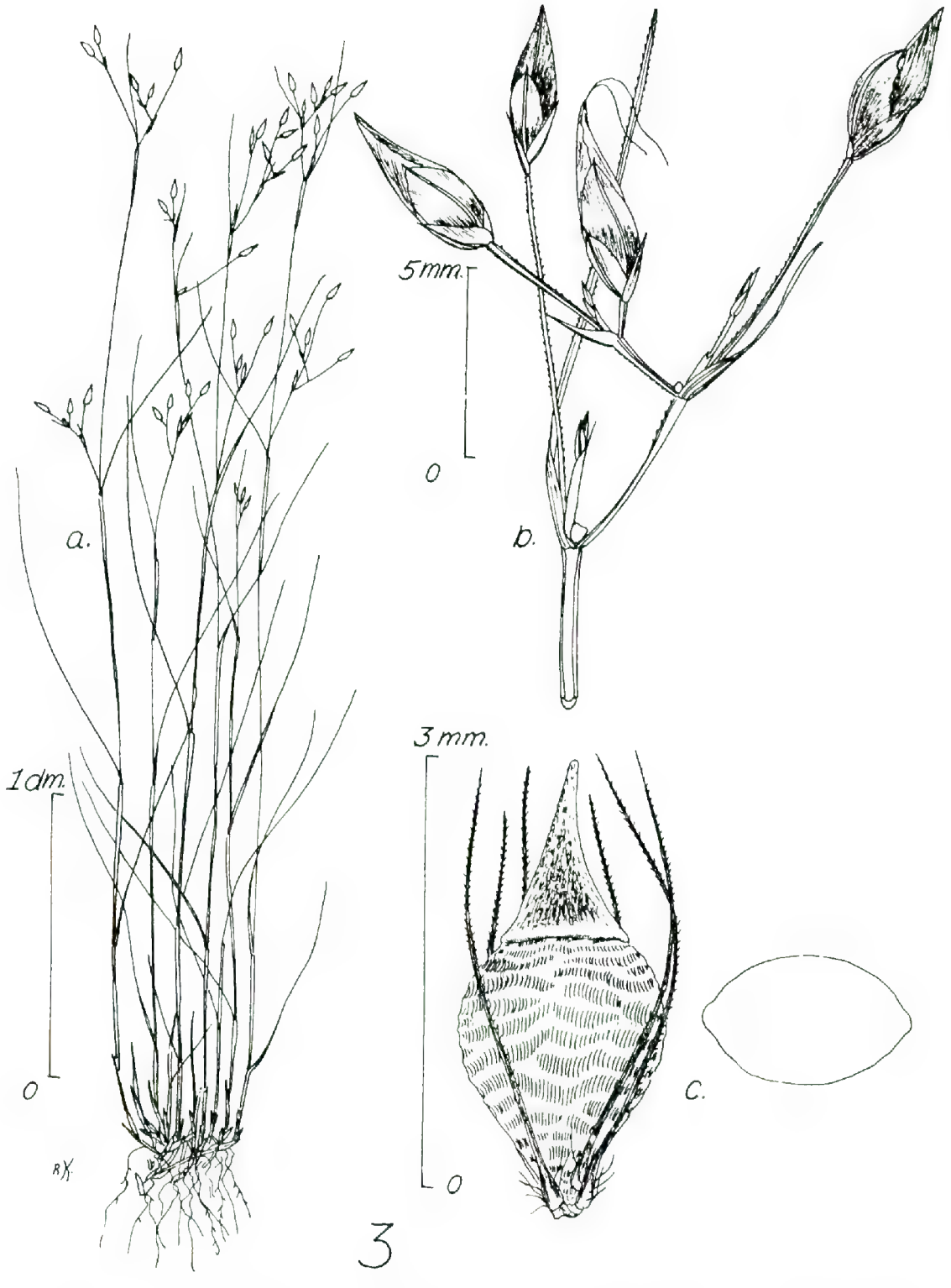

Figure 3. *Rhynchospora stenophylla*. a. Habit sketch. b. Inflorescence. c. Akene and cross section through body. From *Godfrey 56716*.

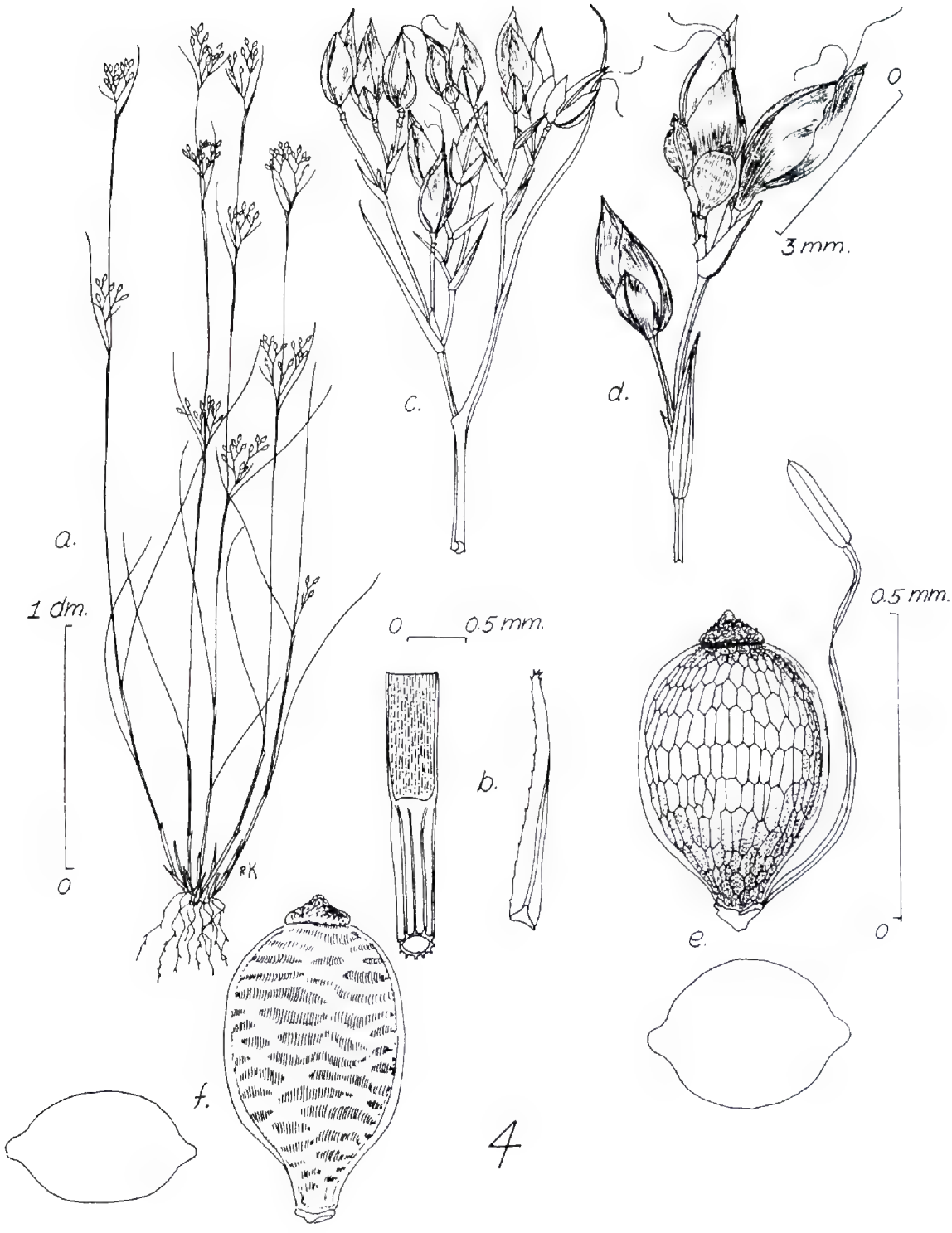

Figure 4. *Rhynchospora divergens*. a. Habit sketch. b. Inner surface of leaf at sheath orifice; blade apex. c. Inflorescence. d. Inflorescence branch, slightly enlarged. e. Akene and cross section through body. From *Kral 47024*. f. *R. pusilla*—akene and cross section through akene body. From *Kral 17578*.

shape. Fertile bracts ovate, ca. 1.5–2.0 mm long, acute, entire, all scales a lustrous reddish-brown, with the single mid-nerve excurrent as a short mucro. Perianth bristles absent. Stamens 1, ca. 1 mm long, the anther narrowly linear, ca. 0.2 mm long. Akene including tubercle 0.7–0.8 mm long, obovoid, short-stipitate, strongly biconvex, with a low but evident, rounded margin, a lustrous pale brown, finely but evidently reticulate, the areoles mostly rectangular, vertically oriented in irregular rows. Tubercle depressed-conic, apiculate, ca. 0.1 mm long.

Sands, sandy-peats and silts of swales in savannas, ditchbanks, seeps, bogs and pondshores in the Coastal plain of the U.S. from S.C. southward through peninsular Florida and west with decreasing frequence into Texas; in the Bahamas, Cuba, Santo Domingo. Flowering and fruiting from June to frost, all year south.

5. RHYNCHOSPORA PUSILLA Chapm. ex. M. A. Curtis, Amer. Journ. Sc. ser. 2. No. 7, p. 409. 1849. Fig. 4.
R. pusilla Chapm., Fl. S.U.S. p. 528. 1860.
R. intermixta C. Wright in Sauv., Fl. Cub. p. 184. 1873.
Phaeocephalum pusillum House, Am. Midl. Nat. 6, p. 201. 1920.

Similar to *R. divergens* Curtis in all ways except the fruit. Akene ca. 0.5 mm long, oblong-obovate, short-stipitate, biconvex, narrowly margined, pale brown to nearly white, lustrous, strongly transversely wavy-rugose, the concavities between the ridges minutely longitudinally striate.

Moist sands, sandy-peats and silts of low meadows, savannas, bogs, seeps and damp shores, mostly in the Coastal Plain from N.C. southward into peninsular Florida, westward into eastern Texas, with localities scattered inland to northern Alabama: Carribean. Flowering from June to frost, all year in frost-free climates.

Curtis (l.c.) appears to have been sent a manuscript description by Chapman, from which he extracted a mere diagnosis, but the identification is unmistakable. Chapman, (l.c.), subsequently published this and *R. divergens* without reference to the Curtis publication. Most authors have treated *R. pusilla* as *R. intermixta.*

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VASCULAR FLORA OF THE RAGLAND HILLS AREA, FORREST AND PERRY COUNTIES, MISSISSIPPI

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ABSTRACT. Thorough field studies of the Ragland Hills area, Forrest and Perry counties, Mississippi began in 1969 and were continued until autumn 1973. The flora and ecology of several rich, mesic ravines were given special consideration. About 250-300 acres of these ravines, although disturbed by man, probably represent the largest and best remnant of the beech-magnolia forest in Mississippi. One-thousand nineteen species of vascular plants, variously distributed among 452 genera in 130 families, are recorded for the area.

The Ragland Hills, located in Forrest and Perry Counties in south Mississippi, are approximately 12 miles south-southeast of Hattiesburg (Fig. 1). It is a maturely dissected area and includes some of the most rugged terrain in south Mississippi. The area is divided by U.S. Highway 98 and is bounded by Caraway Creek on the east, the Leaf River on the north, Weldy Creek on the west, and the Camp Shelby Military Reservation on the south. Approximately 3600 acres, encompassing parts or all of fifteen sections (Sections 9, 10, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26, R12W, T3N, Forrest County; Sections 18, 19, 30, R11W, T3N, Perry County) are included. All land is privately owned with about 90% of the total acreage being in Forrest County.

Most of the state of Mississippi lies within the Physiographic Province known as the Gulf Coastal Plain (Fenneman, 1938). Most of the southern one-third of the state, including Forrest and Perry counties, is in the subdivision referred to as the Longleaf Pine Region or Pine Hills (Lowe, 1921). This subdivision is named for the extensive forest of pine which is dominated by the Longleaf Pine. This region is a maturely dissected highland sloping to the southeast, with elevations ranging from approximately 500 feet to 100 feet (U.S. Geological Survey, 1956).

The Ragland Hills are a part of the north-facing slope of the divide between the Leaf River and Black Creek. They are erosional in origin having been formed by the Leaf River and its tributaries which drain the northern half of Forrest and Perry counties. Elevations range from about 300 feet along the crest of the divide to a little below 100 feet along the Leaf River (U.S. Geological Survey, 1949).

Geologically most of the area is underlain by clays of Miocene Age belonging to the Hattiesburg Clay Formation. Portions of the crest of the divide are underlain by sands and gravels of the Plio-Pleistocene Citronelle

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Formation. These formations are in part overlain by Pleistocene to Recent terrace and alluvial deposits (Mississippi Geological Society, 1969; Foster, 1941).

The soils are primarily sands and sandy loams which are rather sterile (Personal Communication, Soil Conservation Service; Vanderford, 1962). The pH ranges from 4.5 to 5.5. Deep colluvial silty clay loams and organic muck soils are associated with the swamps and poorly drained depressions.

The mean annual precipitation is between 60 and 62 inches. It is rather evenly distributed throughout the year with the autumn being the driest season. The average annual temperature is approximately 67° F with the average July temperature between 81° F and 82° F and a mean January temperature

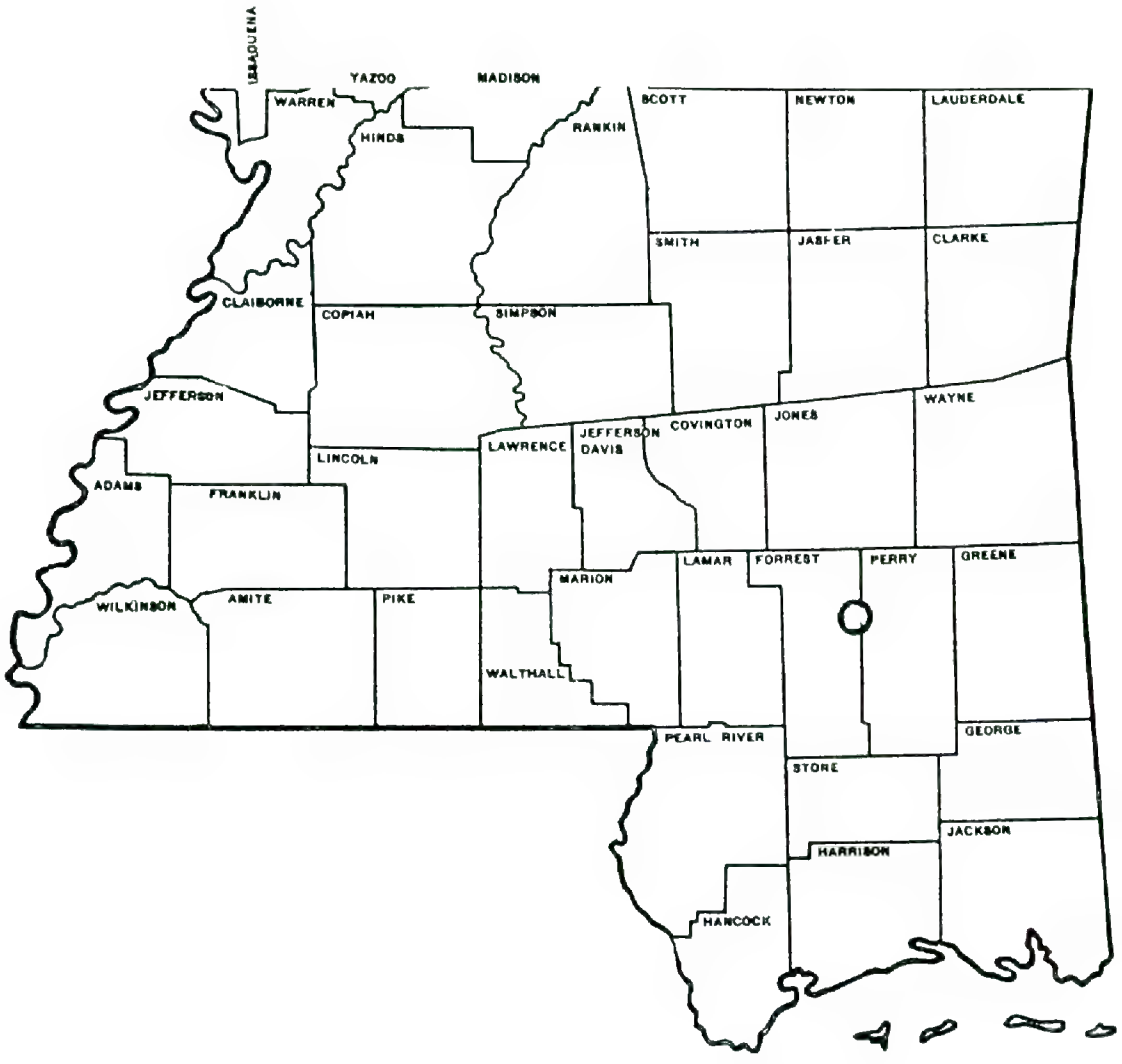

Fig. 1. Area in which study was conducted is indicated by a circle in Forrest and Perry counties, Mississippi.

of 51° F to 52° F (McWhorter, 1962). Temperatures range from approximately 7° F to 106° F.

The effects of human activities are manifest throughout the area. A few dwellings occur but these are restricted mainly to areas adjacent to the highway. There are no dwellings in the ravines. Cutting of the forest began in the 1800's and has continued in varying degrees to the present. Currently both timber and pulpwood are being harvested. A number of access roads crisscross the area, and several sand and gravel pits occur. Recent exploration for oil has resulted in further damage to the forests.

The study area includes not only the ravines but portions of the adjacent divide crest as well as the floodplain of the Leaf River. The plant communities consequently are quite diverse and include river swamps, hardwood bottoms, savannahs, flatwoods, sandhills, bays, and upland forests of pine, mixed pine-hardwood, and hardwood. Also included are the various habitats associated with human activities such as those around dwellings, artificial lakes, in pastures and fields, and along roads and trails. Several species of aquatic plants are found in oxbow lakes, swamps, and artificial lakes and ponds.

The most floristically rich and outstanding plant community is the beech-magnolia forest associated with the mesic ravines along the north slope of the divide. Approximately 250-300 acres of the steepest ravines (N¼, Sec. 24, R12W, T3N, Forrest County; NW¼ of the NW¼, Sec. 19, R11W, T3N, Perry County) have escaped to some degree the destruction that has befallen the native vegetation surrounding these ravines. This is probably the largest and richest remnant of the beech-magnolia forest in Mississippi.

I have attempted to provide as nearly as possible a complete record of the vascular plants which occur in the ravines as well as those which are associated with the adjacent uplands and bottom lands. The collection of specimens and observations of the plants and the area began in 1969 and were continued until autumn 1973. These have been made during all seasons of the year. The annotated list which follows is arranged alphabetically by families and within families. In most cases the scientific names are in accord with those used in the *Manual of the Vascular Plants of Texas* (Correll and Johnston, 1970).

Herbarium specimens are deposited in the Herbarium of the University of North Carolina. Duplicate specimens, when available, were distributed to various other herbaria including GH, MISSA, MO, NY, SMU, US, TENN, and VDB.

The pteridophytes and seed plants of the area are distributed among 452 genera in 130 families. Of the 1019 species which were found in the area, approximately 131 (12.9%) are introduced. A number of the introduced species are of the type that persist around old homesites and probably do not reproduce themselves in this region.

The five largest families which together comprise almost half of the total number of species are: Gramineae (153), Compositae (136), Cyperaceae

(79), Leguminosae (73), and Labiatae (27).

ANNOTATED LIST OF THE VASCULAR FLORA OF RAGLAND HILLS

ACANTHACEAE

Dicliptera brachiata (Pursh) Sprengel. Locally abundant along the Leaf River. Native.
Justicia ovata (Walter) Lindau. Infrequent in swampy places. Native.
Ruellia caroliniensis (Walt.) Steudel. Occasional in pinelands, dryish woods, and old fields. Native.

ACERACEAE

Acer rubrum L. (Incl. *A. rubrum* var. *drummondii* (H. & A.) Sarg.). Frequent in a variety of woodland habitats. Native.
Acer saccharinum L. Occasional along floodplain of river. Native.

AIZOACEAE

Mollugo verticillata L. Common in disturbed places. Introduced.

ALISMATACEAE

Echinodorus cordifolius (L.) Griseb. Infrequent in shallow water of ponds, lakes, and swamps. Native.
Sagittaria graminea Michx. Infrequent in shallow water of ditches, ponds, lakes, streams, and swamps. Native.
Sagittaria latifolia Willd. Locally abundant in shallow water and wet places. Native.
Sagittaria longirostrata (Micheli) J. G. Smith. Infrequent in shallow water and wet places. Native.

AMARANTHACEAE

Alternanthera philoxeroides (Martius) Griseb. Common in ponds, lakes, swamps, and sometimes in wet waste places. Introduced.
Amaranthus hybridus L. Common in cultivated and fallow fields. Native.
Amaranthus viridis L. Common in cultivated and fallow fields, occasional along roadsides. Introduced.

AMARYLLIDACEAE

Hymenocallis occidentalis (LeConte) Kunth. Frequent in low moist woods. Native.
Polianthes virginica (L.) Shinners. Infrequent in open pine and mixed woods. Native.

ANACARDIACEAE

Rhus copallina L. Common in mixed woods, pinewoods, and old fields. Native.
Rhus glabra L. Occasional along woodland borders. Native.
Rhus radicans L. Common in woodlands, disturbed places, and along fences. Native.
Rhus toxicodendron L. Common in upland mixed woods and old fields. Native.
Rhus vernix L. Occasional or frequent in low wet places. Native.

ANNONACEAE

Asimina parviflora (Michx.) Dunal. Occasional in usually dryish mixed woods. Native.

APOCYNACEAE

Trachelospermum difforme (Walter) Gray. Infrequent in low woods. Native.

AQUIFOLIACEAE

Ilex ambigua (Michx.) Torr. Infrequent in upland mixed woods. Native.
Ilex amelanchier M. A. Curtis. Infrequent or rare in low rich woods. Native.
Ilex coriacea (Pursh) Chapman. Common in moist or wet low places. Native.
Ilex decidua Walter. Occasional in swamps, ravines, and along streams. Native.
Ilex glabra (L.) Gray. Common in open pinewoods and moist places. Native.
Ilex longipes Chapman. Infrequent or rare in upland areas. Native.

Ilex opaca Aiton. Frequent in mixed woods and ravines. Native.
Ilex verticillata (L.) Gray. Occasional in low woods. Native.
Ilex vomitoria Aiton. Common in low woods, pinelands, and along wood borders. Native.

ARACEAE

Arisaema dracontium (L.) Schott. Infrequent in ravines and low woods. Native.
Arisaema triphyllum (L.) Schott. Occasional in low woods and ravines. Native.
Orontium aquaticum L. Infrequent in sandy streams and open ponds. Native.

ARALIACEAE

Aralia spinosa L. Frequent in mixed woods and disturbed ravines. Native.

ARISTOLLOCHIACEAE

Aristolochia serpentaria L. (Incl. *A. hastata* Nutt.). Occasional in mesic upland woods and upper slopes of ravines. Native.
Aristolochia tomentosa Sims. Occasional along floodplain of river. Native.
Hexastylis arifolia (Michx.) Small. Frequent in moist or dryish mixed woods and ravines. Native.

ASCLEPIADACEAE

Asclepias amplexicaulis Smith. Infrequent in dry mixed woods. Native.
Asclepias humistrata Walter. Infrequent in sandy loam soils of open, dry upland woods. Native.
Asclepias obovata Elliott. Infrequent in pinewoods and along roadsides. Native.
Asclepias perennis Walter. Infrequent in shallow water of swamps. Native.
Asclepias variegata L. Infrequent in open upland woods and borders of low woods. Native.
Asclepias verticillata L. Infrequent along roadsides and in open upland mixed woods. Native.
Cynanchum laeve (Michx.) Persoon. Infrequent in open mixed woods. Native.

BALSAMINACEAE

Impatiens capensis L. Locally abundant in wet places bordering cypress-tupelo swamps. Native.

BETULACEAE

Alnus serrulata (Ait.) Willd. Common along streams. Native.
Betula nigra L. Frequent along river floodplain. Native.
Carpinus caroliniana Walter. Frequent in mesic woodlands. Native.
Ostrya virginiana (Miller) K. Koch. Frequent in rich woodlands. Native.

BIGNONIACEAE

Bignonia capreolata L. Frequent in mesic woodlands. Native.
Campsis radicans (L.) Seemann. Common along roads, trails, fences, and open woods. Native.
Catalpa bignonioides Walter. Infrequent along streams, roadsides, and near dwellings. Native.
Heliotropium indicum L. Infrequent in open moist places. Introduced.
Myosotis macrosperma Engelm. Infrequent at the edge of old fields. Native.
Onosmodium virginianum (L.) A. DC. Infrequent in open pinelands. Native.

BRASSICACEAE

Cardamine bulbosa (Schreber) BSP. Local in moist deciduous woods. Native.
Cardamine hirsuta L. Frequent in disturbed places. Introduced.
Lepidium virginicum L. Frequent in disturbed places. Native.
Raphanus raphanistrum L. Infrequent in disturbed places. Introduced.

BROMELIACEAE

Tillandsia usneoides L. Common in deciduous (rarely evergreen) trees. Native.

BURMANNIACEAE

Apteria aphylla (Nutt.) Barnhart. Local in mesic woods. Native.

CACTACEAE

Opuntia drummondii Graham. Rare in sandy well-drained soil. Native.

CALLITRICHACEAE

Callitriche terrestris Raf. Infrequent on moist sandy loam in open areas. Native.

CAMPANULACEAE

Lobelia cardinalis L. Local in wet soil bordering swamps and ponds. Native.
Lobelia glandulosa Walter. Infrequent in moist soil bordering open swamps. Native.
Lobelia puberula Michx. Frequent or infrequent in moist to dryish open places. Native.
Lobelia spicata Lam. Infrequent in open woodlands. Native.
Triodanis biflora (R. & P.) Greene. Frequent in disturbed places. Native.
Triodanis perfoliata (L.) Nievw. Frequent in disturbed places. Native.
Wahlenbergia marginata (Thunberg) DC. Common in disturbed places. Introduced.

CAPPARIDACEAE

Cleome houtteana Raf. Occasional escape from cultivation to disturbed places. Introduced.

CAPRIFOLIACEAE

Lonicera japonica Thunberg. Occurs in a variety of habitats, sometimes overrunning native vegetation. Introduced.
Lonicera sempervirens L. Occasional in oak-pine woodlands. Native.
Sambucus canadensis L. Locally abundant in open moist places. Native.
Viburnum dentatum L. Frequent in alluvial woods and low woods. Native.
Viburnum nitidum Ait. Infrequent in swamps and wet woods. Native.
Viburnum nudum L. Locally numerous in swamps and wet woods. Native.
Viburnum rufidulum Raf. Occasional in dry upland woods. Native.

CARYOPHYLLACEAE

Cerastium glomeratum Thuillier. Frequent in disturbed places. Introduced.
Sagina decumbens (Ell.) T. & G. Frequent in disturbed places. Native.
Silene antirrhina L. Frequent along roadsides. Native.
Silene ovata Pursh. Local on upper slopes of ravines. Native.
Stellaria media (L.) Cyrill. Occasional in disturbed places. Introduced.

CELASTRACEAE

Euonymus americanus L. Occasional in low woods. Native.

CERATOPHYLLIACEAE

Ceratophyllum demersum L. Locally abundant in swamps. Native.

CHENOPODIACEAE

Chenopodium album L. Local in cultivated and other disturbed places. Introduced.
Chenopodium ambrosioides L. Infrequent in disturbed places. Introduced.
Chenopodium pumilio R. Br. Rare in disturbed places. Introduced.

CISTACEAE

Helianthemum carolinianum (Walter) Michx. Infrequent in open pinewoods. Native.
Lechea minor L. Occasional along pond borders and in clearings. Native.
Lechea tennifolia Michx. Occasional in dry sandy loam soils of upland areas. Native.
Lechea villosa Ell. Frequent in clearings and upland open woods. Native.

COMMELINACEAE

Commelina caroliniana Walter. Infrequent in disturbed places. Native.
Commelina communis L. Common in disturbed places, usually near dwellings. Introduced.
Commelina diffusa Burman f. Infrequent in disturbed places near dwellings. Native.
Commelina erecta L. Infrequent in disturbed places. Native.
Commelina virginica L. Locally numerous in rich woods. Native.
Tradescantia ohiensis Raf. Frequent along roadsides. Native.

COMPOSITAE

Acanthospermum australe (Loefl.) O. Ktze. Locally numerous in sterile soil in open places. Introduced.

Ambrosia artemisiifolia L. Occasional or sometimes abundant in cultivated fields, fallow fields, and other disturbed places. Native.

Ambrosia trifida L. Locally abundant along floodplain of river. Native.

Antennaria fallax Greene. Infrequent or locally abundant on upper slopes of ravines. Native.

Aster adnatus Nutt. Frequent in open longleaf pinewoods. Native.

Aster concolor L. Occasional in pine or mixed woods. Native.

Aster dumosus L. Frequent in mixed and pinewoods, along roadsides and various disturbed places. Native.

Aster lateriflorus (L.) Britton. Frequent or infrequent along roads, trails, and in mixed woods. Native.

Aster linariifolius L. Occasional in dry pine or mixed woods. Native.

Aster paludosus Ait. Infrequent in usually dry soil of open mixed woods. Native.

Aster patens Ait. Frequent or infrequent in upland mixed woods and pinewoods. Native.

Aster pilosus Willd. Infrequent along roads, wood borders, and edges of fields. Native.

Aster pracaltus Poir. Infrequent in low open places. Native.

Aster simplex Willd. Localized in low moist woods and along river floodplain. Native.

Aster undulatus L. Infrequent in open upland mixed woods. Native.

Baccharis halimifolia L. Frequent along roads and in low moist places. Native.

Bidens bipinnata L. Occasional in disturbed places. Native.

Bidens discoidea (T. & G.) Britt. Occasional in moist low ground. Native.

Bidens frondosa L. Frequent in low woods and moist places. Native.

Bidens mitis (Michx.) Sherff. Common in wet places. Native.

Bigelowia nudata (Michx.) DC. Occasional in moist pinewoods. Native.

Boltonia diffusa Ell. Frequent or infrequent along roads and in low usually open places. Native.

Brintonio discoidea (Ell.) Greene. Frequent in mixed woods. Native.

Cacalia elliottii (Harper) Shinners. Infrequent in moist woods and moist open places. Native.

Cacalia lanceolata Nutt. Infrequent in low pinelands. Native.

Chaptalia tomentosa Vent. Infrequent in open low wet places. Native.

Chrysogonum virginianum L. Frequent in dry mixed woods and open places. Native.

Cirsium carolinianum (Walter) Fern. & Schubert. Infrequent in open disturbed upland woods. Native.

Cirsium horridulum Michx. Occasional along roads and in old fields. Native.

Conyza canadensis (L.) Cronquist. Common in disturbed places. Native.

Conyza floribunda H.B.K. Infrequent in disturbed places. Introduced.

Coreopsis cardaminifolia (DC.) T. & G. Infrequent along roads and in other disturbed places. Native.

Coreopsis lanceolata L. Infrequent in disturbed places. Native.

Coreopsis major Walter. Common in dry open woods. Native.

Coreopsis stenophylla F. E. Boynton. Rare in open disturbed places. Native.

Coreopsis tinctoria Nutt. Infrequent in various disturbed places. Native.

Coreopsis tripteris L. Infrequent in open low ground. Native.

Croptilon divaricatum (Nutt.) Raf. Abundant in sandy loam or sand of open usually disturbed places. Native.

Eclipta alba (L.) Hasskarl. Occasional at the edges of ponds, lakes, swamps, and in wet ditches. Introduced.

Elephantopus carolinianus Willd. Frequent in mesic or dry mixed woods. Native.

Elephantopus elatus Bertoloni. Frequent or infrequent in open pinewoods. Native.

Elephantopus nudatus Gray. Occasional in sandy loam soils of pine and mixed woods. Native.

Elephantopus tomentosus L. Occasional in open pine and mixed woods. Native.

Erechtites hieracifolia (L.) Raf. Occasional in disturbed places. Native.

Erigeron annuus (L.) Persoon. Frequent to infrequent along roads and trails. Native.

Erigeron philadelphicus L. Infrequent in open disturbed places. Native.

Erigeron strigosus Muhl. ex Willd. Frequent along roads, trails, and in open disturbed places. Native.

Eupatorium album L. Infrequent in dry pine or mixed woods. Native.

Eupatorium altissimum L. Infrequent in openings in dry mixed woods. Native.
Eupatorium aromaticum L. Frequent in pine and mixed woods. Native.
Eupatorium capillifolium (Lam.) Small. Common in disturbed places. Native.
Eupatorium coelestinum L. Infrequent in wet ditches and openings in low woods. Native.
Eupatorium compositifolium Walter. Infrequent along roads and in other disturbed places. Native.
Eupatorium fistulosum Barratt. Localized in low wet areas. Native.
Eupatorium hyssopifolium L. Frequent or infrequent in open pinewoods, dry to moist clearings, and fields. Native.
Eupatorium leucolepis (DC.) T. & G. Open usually low pinewoods, not common. Native.
Eupatorium perfoliatum L. Occasional or sometimes common in low woods, borders of swamps, ponds, and lakes, and in wet ditches. Native.
Eupatorium pilosum Walter. Infrequent or rare in open pinewoods. Native.
Eupatorium recurvans Small. Infrequent or locally numerous in moist pinewoods. Native.
Eupatorium rotundifolium L. Common in open pine and mixed woods. Native.
Eupatorium semiserratum DC. Frequent or infrequent in moist pine or mixed woods. Native.
Eupatorium serotinum Michx. Frequent in open disturbed places. Native.
Euthamia graminifolia (L.) Nutt. Infrequent or sometimes locally abundant in moist open places. Native.
Euthamia leptocephala (T. & G.) Greene. Infrequent in open sandy soil. Native.
Euthamia minor (Michx.) Greene. Infrequent or sometimes locally numerous in moist open places. Native.
Facelis retusa (Lam.) Sch.-Bip. Infrequent in pastures and along roads and trails. Introduced.
Gaillardia aestivalis (Walter) H. Rock. Infrequent in dry sandy loam soils of upland mixed woods. Native.
Gnaphalium falcatum Lam. Infrequent or locally numerous along roads and in fields and pastures. Native.
Gnaphalium helleri Britton. Infrequent in dry pinewoods. Native.
Gnaphalium obtusifolium L. Frequent or infrequent in fields open mixed or pinewoods, and along roads and trails. Native.
Gnaphalium pensylvanicum Willd. Frequent or infrequent in disturbed places. Native.
Gnaphalium purpureum L. Frequent in disturbed places. Native.
Helenium amarum (Raf.) H. Rock. Infrequent or locally numerous in pastures, fields, and along roads and trails. Native.
Helenium flexuosum Raf. Infrequent in moist open places. Native.
Helianthus angustifolius L. Frequent in wet or moist soil in open pinewoods, along roadside ditches, and edges of ponds and marshy areas. Native.
Helianthus annuus L. Infrequent in disturbed places. Native.
Helianthus atrorubens L. Infrequent in open mixed woods and at wood borders. Native.
Helianthus heterophyllus Nutt. Infrequent in open pinewoods. Native.
Helianthus hirsutus Raf. Locally numerous or occasional in open upland mixed woods and along roads and trails. Native.
Helianthus microcephalus T. & G. Infrequent and local in mixed woods and at wood borders. Native.
Helianthus radula (Pursh) T. & G. Occasional in open dry pinewoods. Native.
Helianthus resinosus Small. Infrequent or locally numerous in open upland woodlands and at wood borders. Native.
Helianthus strumosus L. Frequent in upland woods and along roads and trails. Native.
Heliopsis gracilis Nutt. Infrequent in openings and at borders of upland mixed woods. Native.
Heterotheca graminifolia (Michx.) Shinners. Frequent in sandy soils along railroads, roads, and in dry woods. Native.
Heterotheca mariana (L.) Shinners. Infrequent in dry woods. Native.
Heterotheca nervosa (Willd.) Shinners. Infrequent or frequent in sandy loam soils of pinewoods and mixed woods. Native.
Heterotheca pilosa (Nutt.) Shinners. Infrequent or rare in disturbed places. Native.
Heterotheca subaxillaris (Lam.) Britt. & Rusby. Infrequent along railroads, in sandy fields and waste places. Native.
Heterotheca trichophylla (Nutt.) Shinners. Infrequent in dry upland wooded sandhills. Native.

Hieracium gronovii L. Infrequent in mixed woods and pinelands. Native.
Iva ciliata Willd. Locally abundant along railroad. Native.
Krigia dandelion (L.) Nutt. Frequent or infrequent along roads. Native.
Krigia oppositifolia Raf. Frequent in disturbed places. Native.
Krigia virginica (L.) Willd. Common along roads, in fields and in lawns. Native.
Kuhnia eupatorioides L. Infrequent in dry mixed woods. Native.
Lactuca canadensis L. Frequent or infrequent along roads, railroads, and trails. Native.
Lactuca floridana (L.) Gaertner. Infrequent in disturbed places. Native.
Lactuca graminifolia Michx. Infrequent along roads in upland mixed woods. Native.
Liatris spicata (L.) Willd. Frequent or infrequent in low moist open areas, low pinelands, and ditches. Native.
Liatris squarrosa (L.) Michx. Frequent in sandy loam soils of upland woods. Native.
Liatris squarrulosa Michx. Infrequent or rare in dry woods. Native.
Marshallia trinervia (Walter) Trel. ex Branner & Coville. Local in low moist places at edges of mixed woods. Native.
Mikania scandens (L.) Willd. Frequent at borders of lakes, ponds, and swamps and in low moist places. Native.
Pluchea camphorata (L.) DC. Frequent or infrequent in marshy places and ditches. Native.
Pluchea foetida (L.) DC. Frequent in low wet places, edges of swamps, and in wet ditches. Native.
Polymnia uvedalia L. Infrequent in rich woods. Native.
Prenanthes altissima L. Infrequent in mesic ravines. Native.
Prenanthes serpentaria Pursh. Infrequent in open mixed woodlands. Native.
Pyrrhopappus carolinianus (Walter) DC. Common in disturbed places. Native.
Rudbeckia hirta L. Frequent along roads, trails, and in sandy woodlands. Native.
Senecio glabellus Poiret. Abundant in low moist woodlands. Native.
Sericocarpus bifoliatus (Walter) Porter. Frequent in open pinewoods and upland mixed woods. Native.
Sericocarpus linifolius (L.) BSP. Frequent or infrequent in dry woodlands. Native.
Silphium gatesii Mohr. Occasional in dry, open upland mixed woods. Native.
Solidago altissima L. Common in old fields, along roads and trails, and in low open places. Native.
Solidago boottii Hooker. Frequent in moist sandy loam soils in mixed woods. Native.
Solidago caesia L. Infrequent in beech-magnolia woods in ravines. Native.
Solidago gigantea Ait. Infrequent or locally abundant in low open moist places. Native.
Solidago odora Ait. Frequent in open dryish woods. Native.
Solidago patula Muhl. Infrequent in low, wet open areas. Native.
Solidago rugosa Miller. Frequent along streams, and in open wet woods and ditches. Native.
Solidago ulmifolia Muhl. ex Willd. Infrequent along river floodplain. Native.
Soliva pterosperma (Juss.) Less. Infrequent in lawns. Introduced.
Sonchus asper (L.) Hill. Infrequent in disturbed places usually near dwellings. Introduced.
Sonchus oleraceus L. Infrequent in disturbed places usually in the vicinity of dwellings. Introduced.
Spilanthes americana (Mutis) Hieron. var. *repens* (Walter) A. H. Moore. Occurs in often dense growths in wet ditches, along river banks, and margins of swamps. Native.
Taraxacum officinale Wiggers. Frequent in a variety of disturbed places. Introduced.
Tetragonotheca helianthoides L. Infrequent in upland mixed woods and disturbed woods. Native.
Trilisa odoratissima (Walter ex J. F. Gmelin) Cassini. Frequent in pine and mixed woods. Native.
Verbesina helianthoides Michx. Infrequent or rare in open mixed woodlands. Native.
Verbesina virginica L. Frequent at the borders of pastures, low woods, and old fields. Native.
Verbesina walteri Shinners. Infrequent along floodplain of river. Native.
Vernonia altissima Nutt. Infrequent in alluvial woods and low ground along roadsides. Native.
Xanthium strumarium L. Infrequent to frequent along river banks. Introduced.
Youngia japonica (L.) DC. Infrequent in disturbed places. Introduced.

CONVOLVULACEAE

Bonamia patens (Desr.) Shinners. Occasional in deep sandy soils of upland areas. Native.

Cuscuta compacta Juss. Local in moist places on both deciduous woody and herbaceous plants. Native.
Cuscuta gronovii Willd. ex R. & S. Local in moist places on woody and herbaceous plants. Native.
Dichondra carolinensis Michx. Local in lawns and pastures. Native.
Ipomoea coccinea L. Infrequent in disturbed places. Introduced.
Ipomoea hederacea Jacq. Infrequent at edges of streams and low woods and borders of fields. Introduced.
Ipomoea lacunosa L. Infrequent along streams, open thickets, and roadside ditches. Native.
Ipomoea pandurata (L.) G. F. W. Meyer. Infrequent in disturbed places. Native.
Ipomoea quamoclit L. Infrequent in disturbed places. Introduced.
Ipomoea trichocarpa Ell. Infrequent along roads and at wood borders. Native.
Jacquemontia tamnifolia (L.) Griseb. Frequent in cultivated ground and various other disturbed places. Native.

CORNACEAE

Cornus alternifolia L. f. Infrequent along streams. Native.
Cornus florida L. Common in various woodland habitats. Native.
Cornus stricta Lam. Infrequent in swamp forests. Native.

CRASSULACEAE

Penthorum sedoides L. Local in wet ditches, edges of swamps, and along streams. Native.

CUCURBITACEAE

Cayaponia grandifolia (T. & G.) Small. Infrequent or rare in rich woods. Native.
Melothria pendula L. Infrequent in alluvial woods. Native.

CUPRESSACEAE

Juniperus virginiana L. Infrequent in mixed woodlands. Native.

CYPERACEAE

Bulbostylis barbata (Rottboell) Clarke. Locally numerous in cultivated ground. Introduced.
Bulbostylis capillaris (L.) Clarke. Frequent in dry sandy loam soils, especially in disturbed places. Native.
Bulbostylis ciliatifolia (Ell.) Fern. Frequent in dry sandy places. Native.
Carex abscondita Mackenzie. Common in low rich woods. Native.
Carex albolutescens Schweinitz. Common in various moist habitats. Native.
Carex atlantica Bailey (Incl. *C. bowei* Mack., *C. incomperta* Bickn.). Infrequent at the edges of open swamps. Native.
Carex complanata Torr. & Hook. Frequent in moist sandy woods and ditches. Native.
Carex crebriflora Wieg. Infrequent in low rich woods. Native.
Carex debilis Michx. Infrequent or locally common along woodland streams and low moist woodlands. Native.
Carex digitalis Willd. Infrequent in rich woods. Native.
Carex flaccosperma Dewey. Infrequent in rich wooded ravines. Native.
Carex folliculata L. Frequent or infrequent in low wet places. Native.
Carex frankii Kunth. Locally abundant in moist places along roads, on river floodplains, and at edges of ponds and lakes. Native.
Carex glaucescens Ell. Infrequent in alluvial woods, wet ditches, and at edges of streams. Native.
Carex hirsutella Mackenzie. Infrequent in low woods. Native.
Carex ignota Dewey. Infrequent or rare in low rich woods. Native.
Carex intumescens Rudge. Frequent in low moist places. Native.
Carex laxiflora Lam. Infrequent in beech-magnolia ravines. Native.
Carex leavenworthii Dewey. Infrequent along roads and in pastures. Native.
Carex leptalea Wahlenberg. Frequent in organic muck in low wet woods. Native.
Carex louisianica Bailey. Infrequent in low woods. Native.
Carex lurida Wahlenberg. Frequent in various moist places. Native.
Carex muhlenbergii Schkuhr. Infrequent in sandy woods. Native.
Carex nigro-marginata Schweinitz. Infrequent in beech-magnolia forest in ravines. Native.

Carex oblita Steudel. Infrequent in wet woods and along streams. Native.
Carex oligocarpa Schkuhr. Infrequent in rich woods. Native.
Carex picta Steudel. Occurs in colonies on the upper slopes of ravines. Native.
Carex reniformis (Bailey) Small. Infrequent or rare in open moist places. Native.
Carex striatula Michx. Occasional in rich woodlands. Native.
Carex styloflexa Buckley. Infrequent in rich woodlands. Native.
Carex tenax Chapman. Locally frequent in wooded sandhills. Native.
Carex triangularis Boeckler. Infrequent or rare in low woodlands. Native.
Carex venusta Dewey. Infrequent in wet woods and along streams. Native.
Carex willdenowii Schkuhr. Infrequent in low rich woods. Native.
Cyperus compressus L. Frequent or infrequent along roads and in fields. Native.
Cyperus engelmannii Steudel. Infrequent in wet ditches and on borders of ponds. Native.
Cyperus esculentus L. Locally abundant in sandy fields. Native.
Cyperus filiculmis Vahl. Infrequent in dry sandy soils. Native.
Cyperus globulosus Aublet. Frequent in disturbed places. Native.
Cyperus haspan L. Frequent in wet ditches at edges of ponds and swamps. Native.
Cyperus iria L. Occasional in wet cultivated ground and depressions. Introduced.
Cyperus ovularis (Michx.) Torr. Infrequent along roads, trails, and in dry woods and fields. Native.
Cyperus plukenetii Fern. Infrequent in dry woods and sandy upland woodlands. Native.
Cyperus pseudovegetus Steudel. Locally frequent in moist places. Native.
Cyperus retrorsus Chapman. Infrequent or locally numerous in sandy low grounds. Native.
Cyperus rotundus L. Locally common in lawns, sandy fields and along roads. Introduced.
Cyperus sesquiflorus (Torr.) Mattfield & Kükenthal. Locally abundant in moist sandy loam soils about ponds, lakes, and in ditches. Native.
Cyperus strigosus L. Frequent or infrequent in various moist disturbed places, and at borders of ponds and swamps. Native.
Cyperus tenuifolius (Steudel) Dandy. Infrequent in moist soil. Native.
Cyperus virens Michx. Locally frequent in various moist or wet places. Native.
Eleocharis microcarpa Torr. Occurs at the borders of ponds and lakes, and in water forming dense mats of attenuated stems. Native.
Eleocharis obtusa (Willd.) Schultes. Locally abundant in moist sandy places. Native.
Eleocharis tortilis (Link) Schultes. Locally abundant in wet soil in open deciduous woods. Native.
Eleocharis tuberculosa (Michx.) R. & S. Locally frequent in moist to wet sandy loam soils. Native.
Fimbristylis autumnalis (L.) R. & S. Locally numerous in open disturbed sandy loam soils. Native.
Fimbristylis miliacea (L.) Vahl. Infrequent in cultivated ground and at borders of ponds and lakes. Introduced.
Fimbristylis puberula (Michx.) Vahl. Frequent or infrequent in open pinewoods, low grounds, and along roads. Native.
Fuirena squarrosa Michx. Local in wet pinelands, moist sandy soil and swamps. Native.
Rhynchospora caduca Ell. Frequent in low sandy woods, swamps, and savannahs. Native.
Rhynchospora cephalantha Gray var. *pleiocephala* Fern. & Gale. Locally numerous in low wet pinewoods. Native.
Rhynchospora compressa Carey. Local in low pinewoods. Native.
Rhynchospora corniculata (Lam.) Gray. Locally abundant in ditches, swamps, and low wet places. Native.
Rhynchospora elliottii A. Dietr. Often abundant in low ground, ditches, and around ponds. Native.
Rhynchospora globularis (Chapman) Small. Common in open moist sandy places low pinewoods, and ditches. Native.
Rhynchospora globularis (Chapm.) Small var. *recognita* Gale. Frequent in open moist sandy places. Native.
Rhynchospora glomerata (L.) Vahl. Local in wet ditches and edges of ponds. Native.
Rhynchospora gracilenta Gray. Infrequent to frequent in low pinelands. Native.
Rhynchospora grayi Kunth. Scattered in deep sand of upland mixed woods. Native.
Rhynchospora inexpansa (Michx.) Vahl. Abundant in sandy loam soils of low pinewoods and along roads. Native.

Rhynchospora miliacea (Lam.) Gray. Infrequent or rare in swamp forests. Native.
Rhynchospora mixta Britt. ex Small. Locally numerous in low pinewoods and swamp forests. Native.
Rhynchospora perplexa Britt. ex Small. Infrequent in low pinelands and swamps. Native.
Rhynchospora rariflora (Michx.) Ell. Locally numerous in low pinewoods and boggy places. Native.
Scirpus cyperinus var. *rubricosus* (Fern.) Gilly. Locally abundant in shallow water of swamps, ponds, and in ditches. Native.
Scirpus koilolepis (Steudel) Gleason. Local in moist sandy open places, frequently in cultivated ground. Native.
Scleria ciliata Michx. Locally numerous in pinelands and dry mixed woods. Native.
Scleria flaccida Steudel. Locally abundant in open wet woods. Native.
Scleria oligantha Michx. Frequent in moist sandy loam of woods and clearings. Native.
Scleria pauciflora Muhl. ex Willd. Infrequent or locally numerous in moist sandy loam of pinewoods, mixed woods, and in clearings. Native.
Scleria triglomerata Michx. Locally abundant in moist to dry sandy loams of open woods and clearings. Native.

CYRILLACEAE

Cyrilla racemiflora L. Frequent at the edges of open swamps, in low pinelands, ditches, and alluvial woods. Native.

DIOSCOREACEAE

Dioscorea quaternata (Walt.) J. F. Gmel. Scattered in moist rich woods of ravines. Native.
Dioscorea villosa L. Scattered in moist rich woods of ravines. Native.

EBENACEAE

Diospyros virginiana L. Frequent in woodlands and fields. Native.

ERICACEAE

Epigaea repens L. Rare in dry sandy loam soil of pine-oak-hickory woods. Native.
Gaylussacia dumosa (Andrz.) T. & G. Occasional in moist to dry pinewoods and clearings. Native.
Kalmia latifolia L. Frequent in beech-magnolia forest in ravines. Native.
Leucothoe axillaris (Lam.) D. Don. Local in beech-magnolia forest of ravines and along streams and swamp forests. Native.
Leucothoe racemosa (L.) Gray. Infrequent in low woods. Native.
Lyonia ligustrina (L.) DC. Infrequent in low moist woods. Native.
Lyonia lucida (Lam.) K. Koch. Infrequent or locally numerous in low wet woods or in shallow swamps. Native.
Oxydendrum arboreum (L.) DC. Occasional or frequent in drier portions of ravines and upland mixed woods. Native.
Rhododendron canescens (Michx.) Sweet. Infrequent in low mixed woods. Native.
Vaccinium arboreum Marshall. Locally abundant in dry open woods. Native.
Vaccinium darrowii Camp. Frequent in pinelands and dry open woods. Native.
Vaccinium elliottii Chapman. Frequent or infrequent in alluvial woods, swampy places, and ravines. Native.
Vaccinium stamineum L. Frequent in mixed woodlands, less frequent in pinelands and ravines. Native.
Vaccinium virgatum Ait. Infrequent in open mixed woods. Native.

ERIOCAULACEAE

Lachnocaulon anceps (Walter) Morong. Localized in ditches and low pinelands. Native.

EUPHORBIACEAE

Acalypha gracilens Gray. Frequent or abundant locally in disturbed places. Native.
Acalypha rhomboidea Raf. Infrequent along roads, trails, borders of fields and woods, and around dwellings. Native.
Acalypha virginica L. Infrequent in disturbed places. Native.
Aleurites fordii Hemsley. Infrequent escape from cultivation to usually disturbed habitats. Introduced.

Cnidoscolus stimulosus (Michx.) Engelm. & Gray. Occasional in dry upland woods. Native.
Croton capitatus Michx. Common in sandy fields and various other disturbed places. Native.
Croton glandulosus L. var. *septentrionalis* Muell. Arg. Frequent along roads, in fallow fields, and other disturbed habitats. Native.
Crotonopsis elliptica Willd. Locally numerous in open sandy places. Native.
Euphorbia corollata L. Frequent in dry woods. Native.
Euphorbia maculata L. (*E. supina* Raf.) Frequent in open disturbed places, especially cultivated ground. Native.
Euphorbia nutans Lag. (*E. preslii* Guss.) Common in various disturbed habitats, especially cultivated fields. Native.
Phyllanthus caroliniensis Walter. Infrequent or locally numerous, usually in disturbed places such as fields. Native.
Phyllanthus urinaria L. Locally abundant in disturbed areas. Introduced.
Sebastiania fruticosa (Bartr.) Fern. Frequent in alluvial woods, at borders of swamps, and occasionally in ravines. Native.
Tragia smallii Shinners. Frequent in dry deep sand of sparsely wooded upland areas. Native.
Tragia urens L. Local in dry deep sand of sparsely wooded sandhills. Native.
Tragia urticifolia Michx. Infrequent or rare at the edges of upland mixed woods. Native.

FAGACEAE

Castanea alnifolia Nutt. var. *floridana* Sargent. Infrequent in upland mixed woods. Native.
Castanea pumila (L.) Mill. var. *asbei* Sudw. Infrequent in upland mixed woods. Native.
Fagus grandifolia Ehrhart. Common in ravines and low moist woods. Native.
Quercus alba L. Frequent in moist or somewhat dry woodlands. Native.
Quercus austrina Small. Rare on banks of river. Native.
Quercus coccinea Muench. Occasional in upland mixed woods. Native.
Quercus falcata Michx. Common in dry woodlands. Native.
Quercus hemisphaerica Bartram. Frequent in usually dryish woodlands. Native.
Quercus incana Bartram. Frequent in wooded sandhills. Native.
Quercus laevis Walter. Frequent in wooded sandhills. Native.
Quercus laurifolia Michx. Infrequent in low moist woods or wet depressions. Native.
Quercus lyrata Walter. Infrequent in moist woods along streams, or in wet depressions. Native.
Quercus margaretta Ashe. Frequent in wooded sandhills and open mixed woods. Native.
Quercus marilandica Muenchh. Frequent in dry upland woods. Native.
Quercus michauxii Nuttall. Occasional in ravines and low rich woods. Native.
Quercus nigra L. Frequent in alluvial woods, ravines and along streams. Native.
Quercus pagoda Raf. Occasional in ravines and low woods. Native.
Quercus phellos L. Occasional in low moist ground. Native.
Quercus shumardii Buckley. Infrequent in ravines and low woods. Native.
Quercus stellata Wang. Frequent in upland mixed woods. Native.
Quercus velutina Lam. Infrequent in upland mixed woods. Native.

GENTIANACEAE

Gentiana saponaria L. Infrequent or rare in recently cleared and burned low woods. Native.
Sabatia angularis (L.) Pursh. Frequent in low places along roads and in low open woods. Native.
Sabatia brachiata Ell. Infrequent in moist ground of open pinelands and along roadways. Native.
Sabatia campanulata (L.) Torrey. Infrequent in open wet places. Native.

GERANIACEAE

Geranium carolinianum L. Frequent in disturbed places, especially roadsides. Native.

GRAMINEAE

Agrostis elliottiana Schultes. Occasional in upland disturbed open places. Native.
Agrostis hyemalis (Walter) BSP. Common along roads and trails and in fields. Native.
Agrostis perennans (Walter) Tuckerman. Frequent in old fields, openings in mixed woods, and along roads and trails. Native.
Alopecurus carolinianus Walter. Localized in moist or wet open places. Native.

Andropogon elliottii Chapman. Frequent in rather dry open woods. Native.
Andropogon gerardii Vitman. Infrequent in open dry places. Native.
Andropogon glomeratus (Walter) BSP. Locally abundant in low open moist areas. Native.
Andropogon ternarius Michx. Frequent in dry open woods. Native.
Andropogon virginicus L. Common in open woods, old fields and pastures, and along roads and trails. Native.
Anthaenantia villosa (Michx.) Beauv. Infrequent in open dry pinewoods and savannahs. Native.
Aristida affinis (Schultes) Kunth. Infrequent in low open pinewoods. Native.
Aristida dichotoma Michx. Common in dry open places. Native.
Aristida lanosa Muhl. ex Ell. Frequent or infrequent in dry sandy loam soils. Native.
Aristida longespica Poiret. Frequent in open, sandy places. Native.
Aristida oligantha Michx. Frequent in open, dry places in sandy loam soils. Native.
Aristida purpurascens Poiret. Frequent in usually dry soil in open pine and mixed woods, open ground, and at wood borders. Native.
Aristida simpliciflora Chapman. Rare in open, dry upland woods. Native.
Aristida virgata Trinius. Localized in open, moist sandy places. Native.
Arundinaria gigantea (Walter) Muhl. Frequent along streams, edges of swamps, and in low woods. Native.
Arundinaria tecta (Walter) Muhl. Infrequent in boggy, open pinewoods. Native.
Avena sativa L. Occasional escape from cultivation to roadsides. Introduced.
Axonopus affinis Chase. Common in open woods, along roads and trails, and in various other disturbed places. Native.
Brachiaria platyphylla (Griseb.) Nash. Frequent in disturbed sandy soils, especially cultivated ground. Native.
Briza minor L. Common along roads and in various other disturbed areas. Introduced.
Bromus commutatus Schrad. Occasional or localized along roads. Introduced.
Bromus japonicus Thunberg. Infrequent along roads. Introduced.
Bromus unioloides (Willd.) H. B. K. Occasional or locally abundant along roads. Introduced.
Cenchrus longispinus (Hackel) Fern. Locally numerous or scattered in open, dry sandy places. Native.
Chasmanthium latifolium (Michx.) Yates. Occasional in low woods and along streams. Native.
Chasmanthium laxum (L.) Yates. Occasional in open moist woods. Native.
Chasmanthium sessiliflorum (Poir.) Yates. Frequent or infrequent in deciduous woods. Native.
Ctenium aromaticum (Walter) Wood. Occasional in open pinewoods. Native.
Cynodon dactylon (L.) Persoon. Common in various disturbed places. Introduced.
Dactyloctenium aegyptium (L.) Beauv. Locally abundant in cultivated ground. Introduced.
Danthonia sericea Nutt. Frequent or infrequent in dry, open woods. Native.
Digitaria filiformis (L.) Koeler. Occasional or locally abundant in sandy soil along roads, railways, and other open places. Native.
Digitaria ischaemum (Schreber) Schreber. Frequent in open disturbed areas. Introduced.
Digitaria sanguinalis (L.) Scopoli. Common along trails, roads, and in fields. Introduced.
Digitaria villosa (Walter) Pers. Occasional in sandy soils in open disturbed places. Native.
Digitaria violascens Link. Occasional in sandy soils in open disturbed places. Native.
Echinochloa crusgalli (L.) Beauv. Occasional or locally abundant in wet places and fields. Introduced.
Eleusine indica (L.) Gaertner. Common along roads and in fields. Introduced.
Elymus virginicus L. Occasional or locally abundant in moist woods and ditches. Native.
Eragrostis amabilis (L.) Wight & Arnott ex Nees. Infrequent in pastures. Introduced.
Eragrostis cilianensis (All.) Lutati. Infrequent in open disturbed places. Introduced.
Eragrostis ciliaris (L.) R. Br. Infrequent in pastures. Introduced.
Eragrostis glomerata (Walt.) L. H. Dewey. Occasional in wet sand or mud along rivers. Native.
Eragrostis hirsuta (Michx.) Nees. Occasional along roads, trails, and in open woods. Native.
Eragrostis oxylepis (Torr.) Torr. Common in sandy soil in open areas. Native.
Eragrostis pilosa (L.) Beauv. Frequent or infrequent along roads and in open ground. Introduced.

Eragrostis refracta (Muhl.) Scribner. Frequent in open woods and various sandy soils. Native.
Eragrostis spectabilis (Pursh) Steudel. Frequent along trails, roads, and other open areas. Native.
Erianthus alopecuroides (L.) Ell. Locally abundant in open moist places. Native.
Erianthus brevibarbis Michx. Localized in open low places. Native.
Erianthus contortus Baldwin ex Ell. Locally abundant in low woods, ditches, and other moist areas. Native.
Erianthus giganteus (Walter) Muhl. Locally abundant in open moist places. Native.
Erianthus strictus Baldwin. Abundant in open wet grounds. Native.
Festuca elatior L. (Incl. *F. arundinacea* Scribn.) Infrequent along roads. Introduced.
Gymnopogon ambiguus (Michx.) BSP. Occasional in open dry woods. Native.
Gymnopogon brevifolius Trinius. Infrequent in open pine and mixed woods. Native.
Hordeum pusillum Nutt. Common in open disturbed habitats. Native.
Hydrochloa caroliniensis Beauv. Localized in mud and shallow water of ponds and lakes. Native.
Imperata brasiliensis Trin. Locally abundant in open disturbed places, principally along roads. Introduced.
Leersia lenticularis Michx. Frequent or infrequent at the borders of swamps, lakes, and in ditches. Native.
Leersia oryzoides (L.) Swartz. Frequent or abundant in mud and shallow water of swamps, ponds, and ditches. Native.
Leersia virginica Willd. Frequent in moist woods and open moist places. Native.
Lolium perenne L. (Incl. *L. multiflorum* Lam.) Frequent along roads. Introduced.
Manisuris rugosa (Nutt.) Kuntze. Infrequent in open moist pinewoods. Native.
Melica mutica Walter. Infrequent in upland mixed woods. Native.
Muhlenbergia expansa (DC.) Trinius. Common in pine-woodlands. Native.
Muhlenbergia schreberi J. F. Gmelin. Locally abundant in open disturbed areas. Native.
Oplismenus setarius (Lam.) R. & S. Frequent in moist woods. Native.
Panicum aciculare Desv. Common in open sandy places and open pinewoods. Native.
Panicum anceps Michx. Frequent along roads, trails, at the edges of fields, and in ditches. Native.
Panicum anceps var. *rhizomatum* (Hitch. & Chase) Fern. Infrequent in moist pinewoods. Native.
Panicum angustifolium Ell. Frequent in open dry woodlands. Native.
Panicum boscii Poiret. Occasional in dry woods. Native.
Panicum commutatum Schultes (Incl. *P. joorii* Vasey). Frequent in low woods, mixed woods, and at wood borders. Native.
Panicum commutatum var. *ashei* (Pearson) Fern. Occasional in dry woods. Native.
Panicum curtifolium Nash. Infrequent in open moist places. Native.
Panicum depauperatum Muhl. Infrequent in dry woods. Native.
Panicum dichotomiflorum Michx. Frequent in various open moist places and low woods. Native.
Panicum dichotomum L. (Incl. *P. barbulatum* Michx., *P. nitidum* Lam., *P. mattamuskeetense* Ashe, *P. roanokense* Ashe, *P. microcarpon* Muhl., *P. yadkinense* Ashe, *P. lucidum* Ashe). Frequent in mesic and mixed woods and various open areas. Native.
Panicum ensifolium Baldw. ex Ell. Occasional in open moist places. Native.
Panicum gymnocarpon Ell. Locally abundant in mud and shallow water in cypress-tupelo swamps and lakes. Native.
Panicum hians Ell. Frequent or infrequent in moist open places. Native.
Panicum lanuginosum Ell. Frequent in open dryish woods, fields, and along roads and trails. Native.
Panicum laxiflorum Lam. Frequent in open mesic woods. Native.
Panicum lindheimeri Nash. Frequent in usually moist open woods and along roads and trails. Native.
Panicum longifolium Torr. Frequent in moist open areas and savannahs. Native.
Panicum mutabile Scribn. & Smith. Occasional in dry mixed woods. Native.
Panicum oligosanthes Schultes. Occasional in open dry areas and in upland mixed woods. Native.
Panicum polyanthes Schultes. Infrequent in moist openings. Native.

Panicum ramosum L. Infrequent or rare in disturbed places. Introduced.
Panicum ravenelii Scribn. & Merr. Infrequent in open dry woods. Native.
Panicum rigidulum Nees. (*P. agrostoides* Sprengel). Common in moist or wet usually open places. Native.
Panicum scabriusculum Ell. Common in marshy places, along streams, at edges of lakes and ponds, and in ditches. Native.
Panicum scabriusculum var. *cryptanthum* (Ashe) Gleason. Common in low wet open places. Native.
Panicum scoparium Lam. Occasional or abundant in moist open habitats. Native.
Panicum sphaerocarpon Ell. Frequent along roads, trails, and various other open dry or moist places. Native.
Panicum stipitatum Nash. Infrequent at the edges of lakes, ponds, swamps, and in ditches. Native.
Panicum strigosum Muhl. Infrequent in open moist ground. Native.
Panicum tenue Muhl. (Incl. *P. albomarginatum* Nash, *P. trifolium* Nash, *P. flavovirens* Nash). Common in low, moist ground in open areas. Native.
Panicum texanum Buckl. Rare along roads. Introduced.
Panicum verrucosum Muhl. Occasional or locally abundant in open moist places. Native.
Panicum villosissimum Nash (Incl. *P. pseudopubescens* Nash). Frequent in open dry woods and along wood borders. Native.
Panicum virgatum L. Frequent or locally abundant in open moist ground. Native.
Paspalum boscianum Flugge. Infrequent in open usually wet areas. Native.
Paspalum ciliatifolium Muhl. Occasional in disturbed places. Native.
Paspalum dilatatum Poir. Common along roads, trails, and in fields. Introduced.
Paspalum floridanum Michx. Occasional in open areas. Native.
Paspalum fluitans (Ell.) Kunth. Infrequent in mud or floating in water. Native.
Paspalum laeve Michx. (Incl. *P. longipilum* Nash, *P. circulare* Nash). Frequent in open places such as fields, along roads and trails. Native.
Paspalum notatum Flugge. Common along roads, trails, and in fields and pastures. Introduced.
Paspalum plicatulum Michx. Infrequent in open moist ground. Native.
Paspalum praecox Walt. (Incl. *P. lentiferum* Lam.). Infrequent in moist open pinewoods. Native.
Paspalum setaceum Michx. (Incl. *P. pubescens* Muhl., *P. debile* Michx., *P. stramineum* Nash, *P. supinum* Bosc., *P. longepedunculatum* LeConte). Occasional or frequent in open woods, fields, along trails and roads, and in other disturbed places. Native.
Paspalum urvillei Steudel. Common along roads, trails, and at edges of fields. Introduced.
Paspalum vaginatum Swartz. Infrequent in marshes. Native.
Phyllostachys aurea Riv. Local along streams and in ravines. Introduced.
Poa annua L. Frequent in various disturbed places. Introduced.
Poa autumnalis Muhl. ex Ell. Occasional in ravines.
Poa chapmaniana Scribner. Occasional or frequent in lawns, vacant lots, and along roads and trails. Native.
Schizachyrium scoparium (Michx.) Nees. Common in upland woods, well-drained open places and along roads and trails. Native.
Schizachyrium tenerum Nees. Common in pine savannahs. Native.
Secale cereale L. Infrequent escape from cultivation to roadsides. Introduced.
Setaria geniculata (Lam.) Beauv. Infrequent in moist soil in various open areas. Native.
Setaria glauca (L.) Beauv. Infrequent in disturbed places. Introduced.
Setaria viridis (L.) Beauv. Infrequent along roads and in vacant lots and railroad yards. Introduced.
Sorghastrum avenaceum (Michx.) Nash. Infrequent in open dry mixed woods. Native.
Sorghastrum elliottii (Mohr) Nash. Infrequent in open upland woods and along roads. Native.
Sorghum bicolor (L.) Moench. Occasional escape from cultivation to roadsides, railroad yards, and vacant lots. Introduced.
Sorghum halepense (L.) Persoon. Occasional or sometimes common in various disturbed places. Introduced.
Sphenopholis filiformis (Chapman) Scribner. Occasional in open dry woods. Native.
Sphenopholis obtusata (Michx.) Scribn. var. *major* (Torr.) Erdman. Frequent in moist ground along roads, trails and other open areas. Native.

Sphenopholis obtusata (Michx.) Scribn. var. *obtusata*. Frequent along roads and trails. Native.
Sporobolus clandestinus (Biehler) Hitchc. Infrequent in open dry woods. Native.
Sporobolus junceus (Michx.) Kunth. Common in pine savannahs. Native.
Sporobolus macer (Trin.) Hitchc. Infrequent or rare in sandy loam soil in open pine and pine-hardwood communities. Native.
Sporobolus indicus (L.) R. Br. Frequent in disturbed places. Introduced.
Stipa avenacea L. Infrequent in well-drained sandy loam soil in upland mixed woods. Native.
Tridens ambiguus (Ell.) Schultes. Infrequent in moist open pinewoods. Native.
Tridens carolinianus (Steud.) Henrard. Infrequent in open sandy woods. Native.
Tridens chapmanii (Small) Chase. Infrequent in open upland mixed woods. Native.
Tridens flavus (L.) Hitchc. Common along roads, trails and in open woods. Native.
Tridens strictus (Nutt.) Nash. Infrequent in open usually moist ground. Native.
Triplasis americana Beauv. Infrequent in dry sandy places. Native.
Triplasis purpurea (Walter) Chapman. Frequent or infrequent in dry sandy places. Native.
Triticum aestivum L. Occasional escape from cultivation to disturbed habitats. Introduced.
Vulpia myuros (L.) C. C. Gmelin. Infrequent in vacant lots, railroad yards, along roads. Introduced.
Vulpia octoflora (Walter) Rydberg. Common along roads and in various other disturbed places. Native.

HALORAGACEAE

Myriophyllum brasiliense Camb. Local in swamps, lakes and ponds. Introduced.
Proserpinaca palustris L. Local in marshy places and shallow water. Native.
Proserpinaca pectinata Lam. Local in shallow water of ponds, in ditches, and marshy areas. Native.

HAMAMELIDACEAE

Hamamelis virginiana L. Frequent in mixed woods and ravines. Native.
Liquidambar styraciflua L. Frequent in moist ravines, low woods. Native.

HIPPOCASTANACEAE

Aesculus pavia L. Frequent in mesic woods. Native.

HYDROPHYLLACEAE

Hydrolea quadrivalvis Walter. Locally abundant in shallow ponds and pools. Native.
Hydrolea uniflora Raf. Locally abundant in shallow ponds. Native.

HYPERICACEAE

Ascyrum hypericoides L. Frequent in open pine and hardwood forests. Native.
Ascyrum stans Michx. Occasional in open pine and mixed woods. Native.
Hypericum denticulatum Walt. Infrequent in low pine-flatwoods. Native.
Hypericum drummondii (Grev. & Hooker) T. & G. Frequent along roads and in dryish open woods and fields. Native.
Hypericum gentianoides (L.) BSP. Frequent along roadways, trails and at edges of fields. Native.
Hypericum galioides Lam. Frequent along streams, wet depressions, at the edges of swamps, and in low pinewoods. Native.
Hypericum mutilum L. Frequent in open wet places around swamps, bogs, ditches, and ponds. Native.
Hypericum nudiflorum Michx. ex Willd. Infrequent or rare along woodland streams. Native.
Hypericum punctatum Lam. Infrequent in woods and fields. Native.
Hypericum setosum L. Occasional in low pine-flatwoods. Native.
Hypericum tubulosum Walter. Frequent at the edges of swamps and in moist woods. Native.
Hypericum virginicum L. Frequent around swamps, marshy areas, and ponds. Native.
Hypericum walteri Gmelin. Frequent in openings in low moist woods. Native.

ILLICIACEAE

Illicium floridanum Ellis. Frequent understory shrub in ravines and on floodplains. Native.

IRIDACEAE

Sisyrinchium angustifolium Miller. Infrequent in moist open woodlands. Native.
Sisyrinchium rosulatum Michx. Occasional in lawns and along roads. Introduced.

JUGLANDACEAE

Carya aquatica (Michx. f.) Nutt. Occasional in swamp forests. Native.
Carya glabra (Miller) Sweet. Occasional in well-drained woods. Native.
Carya illinoensis (Wang.) K. Koch. Frequent in fields, pastures, and at old homesites where planted.
Carya pallida (Ashe) Engler & Graebner. Frequent in well-drained mixed woods. Native.
Carya tomentosa Nutt. Frequent in well-drained mixed woods. Native.

JUNCACEAE

Juncus acuminatus Michx. Infrequent in open wet ditches and wet depressions. Native.
Juncus biflorus Ell. Frequent in open moist places. Native.
Juncus brachycarpus Engelm. Common locally in open moist ground. Native.
Juncus coriaceus Mackenzie. Common in ditches, wet depressions, and about ponds. Native.
Juncus debilis Gray. Infrequent and local in open wet ground. Native.
Juncus dichotomus Ell. Common in open dryish or moist places. Native.
Juncus diffusissimus Buckley. Frequent in usually open wet places about streams, ponds, and in ditches. Native.
Juncus effusus L. Common in wet depressions, ditches, and around ponds. Native.
Juncus elliottii Chapman. Frequent in open wet areas. Native.
Juncus gymnocarpus Coville. Infrequent and local on the borders of lakes. Native.
Juncus marginatus Rostk. Frequent in open moist places. Native.
Juncus polycephalus Michx. Frequent in wet soil in ditches, depressions, and in shallow water in ponds. Native.
Juncus repens Michx. Common at edges of ponds and in wet low places, frequently submerged in ponds. Native.
Juncus scirpoides Lam. Frequent in moist open places. Native.
Juncus tenuis Willd. Frequent in moist or dryish soils in openings. Native.
Juncus trigonocarpus Steudel. Frequent in mud or shallow water, ponds and ditches. Native.
Juncus validus Coville. Infrequent or locally frequent in open wet places. Native.
Luzula bulbosa (Wood) Rydberg. Infrequent in open upland woods. Native.

LABIATAE

Collinsonia canadensis L. Locally frequent in ravines. Native.
Collinsonia serotina Walt. Rare in deciduous woods along streams. Native.
Glechoma hederacea L. Infrequent in open bottom land and woods. Introduced.
Hedeoma hispidum Pursh. Frequent along roads and in pastures. Native.
Hyptis alata (Raf.) Shinners. Common in moist ground along roads and in marshy places. Native.
Hyptis mutabilis (A. Rich.) Brig. Abundant locally in open woods along Leaf River. Introduced.
Lamium amplexicaule L. Frequent along roads and in pastures and lawns. Introduced.
Lamium purpureum L. Infrequent in lawns and pastures. Introduced.
Lycopus rubellus Moench. Frequent in swamps, marshy ground, ditches, and at edges of ponds. Native.
Lycopus virginicus L. Infrequent in low moist woods and around swamps. Native.
Monarda punctata L. Local in dry sandy soil at borders of mixed woods. Native.
Perilla frutescens (L.) Britton. Locally numerous in open disturbed woodlands and pastures. Introduced.
Physostegia virginiana (L.) Bentham. Infrequent in low areas along roads. Introduced.
Prunella vulgaris L. Infrequent along roads, in clearings, fields, and pastures. Native.
Pycnanthemum albescens T. & G. Frequent or infrequent in pinelands and mixed pine-hardwoods. Native.
Pycnanthemum tenuifolium Schrader. Occasional in open low places. Native.
Salvia azurea Lam. Occasional in open upland woods. Native.
Salvia lyrata L. Frequent in lawns and along roads. Native.

Scutellaria elliptica Muhl. Infrequent in dry mixed woods. Native.
Scutellaria integrifolia L. Frequent or infrequent about lakes and ponds, in ditches, and open low ground. Native.
Scutellaria lateriflora L. Infrequent or rare in low moist woods. Native.
Scutellaria ovata Hill var. *bracteata* (Benth.) Blake. Rare in open bottom land woods. Native.
Stachys floridana Shuttlew. Abundant locally in lawns and along open streams. Introduced.
Stachys tenuifolia Willd. Infrequent or rare in bottom land woods. Native.
Teucrium canadense L. Infrequent in bottom land woods. Native.
Trichostema dichotomum L. Frequent in open dry places. Native.
Trichostema setaceum Houttuyn. Frequent in dry open places. Native.

LAURACEAE

Persea borbonia (L.) Spreng. Frequent in ravines, low woods, and borders of swamps. Native.
Sassafras albidum (Nutt.) Nees. Frequent in open upland woods, slopes of ravines, old fields, and wood borders. Native.

LEGUMINOSAE

Albizia julibrissin Durazzini. Frequent escape from cultivation to roadsides and other disturbed habitats. Introduced.
Amorpha fruticosa L. Infrequent along river banks and in open low bottom land woods. Native.
Amphicarpa bracteata (L.) Fern. Infrequent in open upland mixed woods. Native.
Apios americana Medicus. Infrequent in low moist woods or thickets. Native.
Arachis hypogaea L. Infrequent escape from cultivated to waste areas. Introduced.
Astragalus distortus T. & G. Rare in dry open pinewoods. Native.
Baptisia leucantha T. & G. Occasional at wood borders and in open woods. Native.
Cassia fasciculata Michx. Frequent along roads, trails and around fields. Native.
Cassia nictitans L. Frequent along roads, trails, and about fields. Native.
Cassia obtusifolia L. A common weed of cultivated fields. Native.
Cassia occidentalis L. Frequent in cultivated fields. Introduced.
Centrosema virginianum (L.) Bentham. Frequent in upland mixed woods. Native.
Cercis canadensis L. Frequent in mixed woods and ravines. Native.
Clitoria mariana L. Frequent in open well-drained deciduous woods. Native.
Crotalaria angulata Miller. Frequent in dry open woods and open sandy places. Native.
Crotalaria sagittalis L. Infrequent in open dry woods. Native.
Crotalaria spectabilis Roth. Infrequent along roads and in fields. Introduced.
Desmodium ciliare (Muhl. ex Willd.) DC. Frequent along wood borders, roads, and edges of fields. Native.
Desmodium glabellum (Michx.) DC. Frequent in open areas such as fields, borders of woods, and along trails. Native.
Desmodium glutinosum (Muhl. ex Willd.) Wood. Infrequent in ravines. Native.
Desmodium laevigatum (Nutt.) DC. Scattered in open upland woods. Native.
Desmodium lineatum DC. Infrequent in dry open mixed woods. Native.
Desmodium nudiflorum (L.) DC. Infrequent in ravines. Native.
Desmodium obtusum (Muhl. ex Willd.) DC. Frequent in open mixed woods and along woods and fields. Native.
Desmodium paniculatum (L) DC. Frequent in fields and open dryish woods. Native.
Desmodium perplexum Schubert. Infrequent in open mixed woods and at borders of fields. Native.
Desmodium rotundifolium DC. Frequent or occasional in open mixed woods. Native.
Desmodium strictum (Pursh) DC. Infrequent in wooded sandhills. Native.
Desmodium tortuosum (Swartz) DC. Abundant locally in fallow fields. Introduced.
Desmodium viridiflorum (L.) DC. Occasional or frequent in well-drained open mixed woods. Native.
Erythrina herbacea L. Frequent in upland mixed woods. Native.
Galactia macreei M. A. Curtis. Infrequent in mixed woods, new clearings, and thickets. Native.
Galactia regularis (L.) BSP. Occasional in wooded sandhills. Native.
Galactia volubilis (L.) Britton. Frequent along wood borders, in open woods, and thickets. Native.

Glycine max (L.) Merrill. An occasional escape from cultivation to roadsides. Introduced.
Lathyrus hirsutus L. Infrequent along roads. Introduced.
Lespedeza capitata Michx. Frequent in open pinewoods, occasional in dryish mixed woods and at edges of fields. Native.
Lespedeza cuneata (Dumont) G. Don. Infrequent or frequent along roads. Introduced.
Lespedeza hirta (L.) Hornemann. Frequent in dry open woods. Native.
Lespedeza x *nuttallii* Darl. Infrequent or rare on roadsides. Native.
Lespedeza procumbens Michx. Infrequent in open woods. Native.
Lespedeza repens (L.) Barton. Frequent or infrequent in dry upland woods and along roads and trails. Native.
Lespedeza striata (Thunb.) H. & A. Locally abundant in disturbed places. Introduced.
Lespedeza stuevei Nutt. Infrequent in open upland woods. Native.
Lespedeza violacea (L.) Persoon. Infrequent in openings of upland woods. Native.
Lespedeza virginica (L.) Britton. Frequent at the borders of fields, along roads and trails. Native.
Lupinus villosus Willd. Local in dry open woods. Native.
Petalostemum carolinianum (Lam.) Sprague. Frequent in well-drained upland woods, principally in sandhills. Native.
Phaseolus polystachios (L.) BSP. Infrequent in ravines. Native.
Pueraria lobata (Willd.) Ohwi. Abundant locally along highways. Introduced.
Rhynchosia pitcheria Burkhart. Infrequent in deep, well-drained sand. Native.
Rhynchosia reniformis DC. Frequent in dry open woods. Native.
Rhynchosia tomentosa (L.) H. & A. Infrequent in open dry woods. Native.
Schrankia microphylla (Solander ex Smith) MacBride. Frequent in dry open mixed woods. Native.
Sesbania punicea (Cav.) Benth. Rare on river banks. Introduced.
Strophostyles helvola (L.) Ell. Occasional in clearings and dry open woods. Native.
Strophostyles umbellata (Muhl. ex Willd.) Britt. Infrequent in upland mixed woods and clearings. Native.
Stylosanthes biflora (L.) BSP. Frequent in disturbed woodland. Native.
Tephrosia florida (Dietrich) C. E. Wood. Frequent in open dryish pine and mixed woods. Native.
Tephrosia spicata (Walter) T. & G. Infrequent in open woods. Native.
Tephrosia virginiana (L.) Pers. Frequent in open pine and mixed woodland. Native.
Trifolium arvense L. Abundant locally in open disturbed areas. Introduced.
Trifolium campestre Schreber. Frequent along roads and in lawns and pastures. Introduced.
Trifolium dubium Sibthorp. Frequent in disturbed places. Introduced.
Trifolium incarnatum L. Infrequent on roadsides. Introduced.
Trifolium repens L. Local in fields and pastures. Introduced.
Trifolium vesiculosum Savi. Infrequent or rare along roads. Introduced.
Vicia angustifolia Reichard. Common locally along roads and at borders of fields. Introduced.
Vicia caroliniana Walter. Infrequent at borders of upland mixed woods. Native.
Vicia dasycarpa Tenore. Occasional along roads. Introduced.
Vicia tetrasperma (L.) Moench. Local along roads. Introduced.
Wisteria frutescens (L.) Poiret. Infrequent at edges of swamps. Native.
Wisteria sinensis (Sims) Sweet. Rare along roads. Introduced.

LEMNACEAE

Lemna valdiviana Phillipi. Frequent or infrequent in swamps and ponds. Native.
Spirodela oligorhiza (Kurtz) Hegelm. Frequent or infrequent in swamps and ponds. Native.
Spirodela polyhiza (L.) Schleid. Frequent or infrequent in lakes and swamps. Native.
Wolffiella floridana (J. D. Smith) Thompson. Locally numerous in swamps. Native.

LENTIBULARIACEAE

Utricularia biflora Lam. Locally abundant or occasional in shallow water or marshy places. Native.

LILIACEAE

Aletris aurea Walter. Occasional in moist pinelands. Native.
Aletris farinosa L. Occasional in pinelands. Native.

Allium canadense L. Frequent along roads. Native.
Allium canadense var. *mobilense* (Regel) Ownbey. Common along roads. Native.
Chamaelirium luteum (L.) Gray. Occasional in ravines. Native.
Hemerocallis fulva L. Infrequent at old homesites. Introduced.
Lilium michauxii Poir. Occasional on upper slopes of ravines. Native.
Medeola virginiana L. Frequent in ravines. Native.
Melanthium virginicum L. Infrequent or frequent in wet grass-sedge communities. Native.
Nothoscordum bivalve (L.) Britt. Common on roadsides, in lawns, and at old homesites. Native.
Smilax bona-nox L. Occasional in thickets, upland woods, and on floodplains. Native.
Smilax cirrhata (Engelm.) Watson var. *hugeri* (Small) Ahles. Occasional in ravines. Native.
Smilax glauca Walter. Frequent in a variety of habitats. Native.
Smilax hispida Muhl. Infrequent in bottom land woods. Native.
Smilax laurifolia L. Frequent in alluvial woods, around swamps and lakes, and various other habitats. Native.
Smilax pulverulenta Michx. Infrequent in ravines. Native.
Smilax pumila Walter. Frequent in dry open mixed and deciduous woodland. Native.
Smilax rotundifolia L. Frequent in moist thickets, deciduous woods, along fence rows, and at wood borders. Native.
Smilax smallii Morong. Frequent or infrequent in mixed moist woods and along streams. Native.
Smilax walteri Pursh. Occasional in bays and marshy places.
Trillium cuneatum Raf. Infrequent to locally abundant in ravines and low rich woods. Native.
Uvularia perfoliata L. Frequent in ravines. Native.
Uvularia sessilifolia L. Frequent in ravines. Native.
Yucca smalliana Fernald. Infrequent in dry, sandy loam soil in dryish open places. Native.

LINACEAE

Linum medium (Planchon) Britt. Frequent in open places about fields and along roads and trails. Native.
Linum striatum Walter. Infrequent in low open places, ditches, and borders of boggy areas. Native.

LOGANIACEAE

Gelsemium sempervirens (L.) Aiton f. Frequent in open areas in woods. Native.
Gelsemium rankinii Small. Scattered and not frequent in open woods and along trails. Native.
Spigelia marilandica L. Infrequent or locally numerous on slopes of ravines and at edge of low mixed woods. Native.

LYCOPODIACEAE

Lycopodium alopecuroides L. Occasional in wet ditches. Native.

LYTHRACEAE

Rotala ramosior (L.) Koehne. Infrequent around lakes and in wet depressions. Native.

MAGNOLIACEAE

Liriodendron tulipifera L. Frequent in ravines and alluvial woods. Native.
Magnolia acuminata L. Frequent or infrequent in ravines. Native.
Magnolia grandiflora L. Common in ravines, occasional in low rich woods. Native.
Magnolia macrophylla Michx. Common in ravines. Native.
Magnolia pyramidata Bartram ex Pursh. Frequent in ravines. Native.
Magnolia virginiana L. Frequent in wet low areas of ravines, bays, occasional along streams. Native.

MALVACEAE

Callirhoe papaver (Cav.) A. Gray. Frequent but local along roads. Native.
Hibiscus aculeatus Walter. Frequent along roads and at edges of low pinewoods. Native.
Modiola caroliniana (L.) G. Don. Infrequent or rare in open ground near dwellings and

along roads. Native.
Sida rhombifolia L. Rather common along roads and at edges of fields. Introduced.
Sida spinosa L. Frequent along roads and around fields. Native.

MAYACACEAE

Mayaca aubletii Michx. Abundant locally in shallow water and mud. Native.

MELASTOMATACEAE

Rhexia alifanus Walter. Frequent in open pine-flatwoods and openings in upland mixed woods. Native.
Rhexia mariana L. Locally numerous ditches, open pine-flatwoods, and borders of ponds. Native.
Rhexia nashii Small. Infrequent in wet ditches and edges of marshy areas. Native.
Rhexia virginica L. Local in ditches, moist pinewoods, and borders of ponds. Native.

MELIACEAE

Melia azedarach L. Naturalized in openings, wood borders and roadsides. Introduced.

MENISPERMACEAE

Calycocarpum lyoni (Pursh) Gray. Infrequent or rare in bottom land woods. Native.
Cocculus carolinus (L.) DC. Frequent in disturbed woods and along roads and trails. Native.

MORACEAE

Morus rubra L. Frequent in ravines, borders of swamps, and low woods. Native.

MYRICACEAE

Myrica cerifera L. Common in flatwoods, savannahs, and edges of ponds and streams. Native.
Myrica heterophylla Raf. Local in pine-flatwoods and bays. Native.

NYMPHAEACEAE

Brasenia schreberi J. F. Gmelin. Common in some ponds and lakes. Native.
Cabomba caroliniana Gray. Abundant locally in swamps. Native.
Nuphar luteum (L.) Sibthorp & Smith ssp. *macrophyllum* (Small) E. O. Beal. Common locally in open swamps and lakes. Native.

NYSSACEAE

Nyssa aquatica L. Abundant in swamps. Native.
Nyssa biflora Walter. Common in bays, various swamps and borders of streams. Native.
Nyssa sylvatica Marshall. Common in moist or dry woods. Native.

OLEACEAE

Chionanthus virginicus L. Occasional on the upper slopes of ravines and in upland mixed woods. Native.
Forestiera acuminata (Michx.) Poir. Occasional in low wet woods, borders of streams, and edges of swamps. Native.
Fraxinus americana L. Occasional in ravines and other mesic woods. Native.
Fraxinus caroliniana Miller. Infrequent or rare in swamps. Native.
Fraxinus pennsylvanica Marsh. Occasional in low mesic woods. Native.
Ligustrum japonicum Thunberg. Infrequent in open ravines. Introduced.
Ligustrum sinense Lour. Frequent in fence rows and along wood borders. Introduced.
Osmanthus americana (L.) Gray. Frequent in moist or dry mixed woods. Native.

ONAGRACEAE

Gaura biennis L. Occasional along roads and trails. Native.
Gaura filipes Spach. Occasional in open dryish woods. Native.
Ludwigia alternifolia L. Frequent in wet ditches, low moist woods, and borders of ponds. Native.
Ludwigia decurrens Walter. Frequent in open moist woods, borders of ponds, and in marshy places. Native.
Ludwigia glandulosa Walter. Occasional in low woods and marshy places. Native.

Ludwigia leptocarpa (Nutt.) Hara. Occasional around ponds, marshy areas, and in wet ditches. Native.
Ludwigia linearis Walter. Frequent in low moist open areas and around ponds. Native.
Ludwigia palustris (L.) Ell. Abundant locally in shallow water or mud. Native.
Ludwigia pilosa Walter. Locally abundant in shallow water in open ground. Native.
Oenothera biennis L. Infrequent or locally numerous along roads and in old fields. Native.
Oenothera fruticosa L. Common in cultivated and fallow fields and along roads. Native.

OPHIOGLOSSACEAE

Botrychium biternatum (Sav.) Underwood. Occasional in ravines and bottom land forests. Native.
Botrychium virginianum (L.) Swartz. Occasional in low woods and ravines. Native.
Ophioglossum crotalophoroides Walter. Infrequent or rare in sandy loam soil along roads. Native.

ORCHIDACEAE

Calopogon pallidus Chapman. Infrequent in wet ditches and moist grass-sedge communities. Native.
Corallorhiza odontorhiza (Willd.) Nutt. Infrequent or rare in ravines. Native.
Corallorhiza wisteriana Conrad. Infrequent or rare in ravines. Native.
Habenaria ciliaris (L.) R. Br. Infrequent in open pine-flatwoods. Native.
Habenaria repens Nutt. Occasional in ponds and open swamps. Native.
Listera australis Lindley. Infrequent in ravines. Native.
Malaxis unifolia Michx. Rare in ravines. Native.
Ponthieva racemosa (Walter) Mohr. Infrequent or rare in ravines. Native.
Spiranthes cernua (L.) Richard. Occasional at borders of swamps and lakes. Native.
Spiranthes laciniata (Small) Ames. Infrequent in moist woods and along ponds. Native.
Spiranthes vernalis Engelm. & Gray. Occasional in moist open places. Native.
Tipularia discolor (Pursh) Nutt. Rare in ravines. Native.

OROBANCHACEAE

Epifagus virginiana (L.) Barton. Infrequent or frequent in ravines. Native.

OSMUNDACEAE

Osmunda cinnamomea L. Frequent in bays, about swamps, and wet areas of ravines. Native.
Osmunda regalis L. var. *spectabilis* (Willd.) Gray. Locally numerous in open wet areas of ravines, low moist woods, and around swamps. Native.

OXALIDACEAE

Oxalis dillenii Jacquin. Frequent in old fields, gardens, and along roads and trails. Native.
Oxalis priceae Small. Infrequent or rare at edge of mixed woods. Native.
Oxalis rubra St. Hil. An escape from cultivation and established locally in disturbed places. Introduced.
Oxalis stricta L. Frequent along roads and in lawns and fields. Native.
Oxalis violacea L. Infrequent in disturbed mesic woods and on road banks. Native.

PALMAE

Rhapidophyllum hystrix (Fraser) H. Wendl. Rare along streams in ravines. Native.
Sabal minor (Jacq.) Pers. Occasional in ravines and bottom land hardwoods. Native.

PAPAVERACEAE

Sanguinaria canadensis L. Occasional in beech-magnolia forest in ravines. Native.

PASSIFLORACEAE

Passiflora incarnata L. Frequent along roads, trails and fence rows and in old fields. Native.
Passiflora lutea L. Infrequent in moist woods. Native.

PHRYMACEAE

Phryma leptostachya L. Frequent in beech-magnolia forest in ravines. Native.

PHYTOLACCACEAE

Phytolacca americana L. Common on river floodplain, occasional or frequent in a variety of disturbed places. Native.

PINACEAE

Pinus echinata Miller. Frequent or common in well-drained sandy loam soils in upland areas. Native.

Pinus glabra Walter. Frequent in moist woods on river terraces and in ravines. Native.

Pinus palustris Miller. Common in savannahs, flatwoods; occasional in well-drained woods. Native.

PLANTAGINACEAE

Plantago aristata Michx. Frequent along roads and trails and other disturbed places. Native.

Plantago hybrida Bart. Local in moist open ground. Native.

Plantago lanceolata L. Frequent in various disturbed places such as fields, open woods, and along roads and trails. Native.

Plantago rugelii Dcne. Infrequent in open low woods. Native.

Plantago virginica L. Common along roads and trails. Native.

POLEMONIACEAE

Phlox pilosa L. Frequent in clearings, open mixed woods, and along roads. Native.

Phlox pilosa subsp. *detonsa* (Gray) Wherry. Occasional in clearings. Native.

POLYGALACEAE

Polygala cruciata L. Infrequent or rare in wet open flatwoods. Native.

Polygala grandiflora Walter. Occasional in upland mixed woods. Native.

Polygala incarnata L. Occasional in open pinewoods. Native.

Polygala mariana Miller. Infrequent in open wet places. Native.

Polygala nana (Michx.) DC. Frequent in moist sandy woods. Native.

POLYGONACEAE

Brunnichia ovata (Walter) Shinners. Locally abundant along rivers, creeks, and about swamps. Native.

Persicaria hydropiperoides (Michx.) Small. Frequent about ponds, lakes, swamps, and in ditches. Native.

Persicaria pensylvanica (L.) Small. Infrequent in moist open ground. Native.

Persicaria punctata (Ell.) Small. Abundant locally or scattered in open wet places or shallow water. Native.

Polygonum convolvulus L. Infrequent in open dryish woods. Introduced.

Rumex crispus L. Common in disturbed areas. Introduced.

Rumex hastatulus Baldwin ex Ell. Frequent along roads, trails, and along fields and wood borders. Native.

Rumex pulcher L. Infrequent in open moist woods and along roads. Introduced.

Tovara virginiana (L.) Raf. Frequent in low woods and moist ravines. Native.

POLYPODIACEAE

Asplenium platyneuron (L.) Oakes. Frequent on upper slopes of ravines, in dryish woods, and along roads, fence rows, and wood borders. Native.

Athyrium asplenioides (Michx.) A. A. Eaton. Frequent in ravines and low wet places. Native.

Lorinseria areolata (L.) Presl. Frequent in various moist or wet places. Native.

Onoclea sensibilis L. Frequent in moist woods, borders of ponds and swamps, and in ditches. Native.

Polypodium polypodioides (L.) Watt. Localized on trunks and branches of deciduous trees. Native.

Polystichum acrostichoides (Michx.) Schott. Frequent in ravines. Native.

Pteridium aquilinum (L.) Kuhn. Common in well-drained soils along roads, trails, and wood borders. Native.

Thelypteris dentata (Forsk.) E. St. John. Infrequent in ravines. Native.

Thelypteris hexagonoptera (Michx.) Weatherby. Common in ravines. Native.

Thelypteris normalis (C. Chr.) Moxley. Common along streams in ravines and in ditches. Native.
Thelypteris palustris Schott. Common in wet ditches and other wet or seasonally inundated ground. Native.
Thelypteris torresiana (Gaudich.) Alston. Infrequent or rare along woodland streams. Native.
Woodwardia virginica (L.) Smith. Frequent in low moist places. Native.

PORTULACACEAE

Portulaca oleracea L. Infrequent in open sandy soil. Introduced.

POTAMOGETONACEAE

Potamogeton berchtoldii Fieber. Infrequent in lakes. Native.
Potamogeton diversifolius Raf. Infrequent in lakes and swamps. Native.

PRIMULACEAE

Centunculus minimus L. Very local in upland wet depressions. Native.

RANUNCULACEAE

Clematis virginiana L. Infrequent in open low woods and along streams. Native.
Delphinium carolinianum Walter. Infrequent in open dryish places. Native.
Ranunculus abortivus L. Frequent in lawns, along roads and trails, and various other places. Native.
Ranunculus fascicularis Muhl. Frequent in open sandy loam soils. Native.
Ranunculus parviflorus L. Infrequent in disturbed places. Introduced.
Ranunculus pusillus Poir. Frequent in seasonally inundated pools. Native.
Thalictrum polygamum Muhl. Infrequent or rare in low rich woods along Leaf River. Native.
Xanthorhiza simplicissima Marshall. Rare in sandy soil along Weldy Creek. Native.

RHAMNACEAE

Berchemia scandens (Hill) K. Koch. Frequent in mesic woods. Native.
Ceanothus americanus L. Frequent in upland woods. Native.
Rhamnus caroliniana Walter. Occasional in ravines and mixed hardwoods. Native.

ROSACEAE

Agrimonia microcarpa Wallroth. Infrequent in upland mixed woods. Native.
Agrimonia pubescens Wallroth. Infrequent in upland mixed woods. Native.
Amelanchier arborea (Michx. f.) Fern. Frequent in ravines. Native.
Crataegus alma Beadle. Frequent in upland woods. Native.
Crataegus marshallii Eggl. Frequent in deciduous and mixed woods. Native.
Crataegus opaca Hook. & Arn. Infrequent in wet open depressions. Native.
Duchesnea indica (Andrz.) Focke. Infrequent or common in areas near dwellings and open sandy places. Introduced.
Fragaria virginiana Duchn. Infrequent or rare in open low woods. Native.
Prunus angustifolia Marshall. Common in open dry woods. Native.
Prunus caroliniana Ait. Frequent in low woods and ravines. Native.
Prunus mexicana S. Wats. Rare in dry open woods. Native.
Prunus persica (L.) Barsch. Rare escape to roadsides. Introduced.
Prunus serotina Ehrhart. Frequent in various woodland habitats. Native.
Prunus umbellata Ell. Frequent or infrequent in well-drained open mixed woods. Native.
Pyrus angustifolia Ait. Infrequent in mixed woods and at wood borders. Native.
Pyrus arbutifolia (L.) L. f. Locally numerous in bays and marshy places. Native.
Rosa bracteata Wendland. Locally abundant along railroad. Introduced.
Rosa carolina L. Infrequent in open upland woods. Native.
Rubus argutus Link. Frequent at borders of low woods, edges of fields, and in open woods. Native.
Rubus betulifolius Small. Frequent in moist woods. Native.
Rubus flagellaris Willd. Infrequent or rare in upland hardwoods. Native.

Rubus trivialis Michx. Common along railroads, trails, and in a variety of disturbed habitats. Native.

RUBIACEAE

Cephalanthus occidentalis L. Frequent about lakes and swamps, and in shallow water. Native.
Diodia teres Walter. Frequent in dry, open areas. Native.
Diodia virginiana L. Frequent around ponds and other wet places. Native.
Galium aparine L. Common in open disturbed places. Native.
Galium circaezans Michx. Occasional in ravines. Native.
Galium pilosum Ait. Occasional in mixed woods and ravines. Native.
Galium tinctorium L. Infrequent in mesic woods. Native.
Galium uniflorum Michx. Infrequent in ravines. Native.
Hedyotis boscii DC. Occasional in low moist areas. Native.
Hedyotis corymbosa (L.) Lam. Infrequent in open moist ground. Introduced.
Hedyotis uniflora (L.) Lam. Infrequent in moist sandy places. Native.
Houstonia procumbens (J.F. Gmelin) Standley. Occasional in sandy loam in pine and mixed woods. Native.
Houstonia purpurea L. Frequent in mesic woods. Native.
Houstonia pusilla Schoepf. Frequent in open sandy loam soils. Native.
Mitchella repens L. Common in ravines. Native.
Richardia scabra L. Common in cultivated and fallow fields. Introduced.

RUTACEAE

Citrus trifoliata L. Rare along the Leaf River. Introduced.
Ptelea trifoliata L. Infrequent along the Leaf River. Native.

SALICACEAE

Populus deltoides Marshall. Frequent along Leaf River, rarely in wet soil at sand and gravel pits. Native.
Salix nigra Marshall. Common along Leaf River and about lakes and swamps. Native.

SAPOTACEAE

Bumelia lycioides (L.) Pers. Rare long Leaf River. Native.

SAURURACEAE

Saururus cernuus L. Common around lakes and swamps. Native.

SAXIFRAGACEAE

Decumaria barbara L. Frequent in ravines. Native.
Hydrangea quercifolia Bartr. Frequent in ravines. Native.
Itea virginica L. Frequent in shallow water or wet soil about swamps, ponds, and bays. Native.

SCHISANDRACEAE

Schisandra glabra (Brickell) Rehder. Rare in ravines. Native.

SCHIZAEACEAE

Lygodium japonicum (Thunb.) Swartz. Occasional in disturbed woods in low areas. Introduced.

SCROPHULARIACEAE

Agalinis setacea (J.F. Gmelin) Raf. Frequent in open dry woods. Native.
Agalinis tenuifolia (Vahl) Raf. Occasional in old fields and clearings. Native.
Aureolaria dispersa (Small) Pennell. Occasional along roads and in open upland woods. Native.
Aureolaria pectinata (Nutt.) Pennell. Infrequent in dry open woods. Native.
Aureolaria virginica (L.) Pennell. Infrequent in mixed woods. Native.
Buchnera americana L. Frequent in pine-flatwoods. Native.
Buchnera floridana Gandoger. Occasional in pine-flatwoods. Native.
Gratiola pilosa Michx. Infrequent in pine-flatwoods. Native.

Gratiola virginiana L. Infrequent in wet open places. Native.
Linaria canadensis (L.) Dumont. Common in a variety of open disturbed habitats. Native.
Lindernia anagallidea (Michx.) Pennell. Local in open wet areas. Native.
Lindernia dubia (L.) Pennell. Infrequent along streams. Native.
Mecardonia acuminata (Walter) Small. Occasional in moist open places. Native.
Micranthemum umbrosum (Walter) Blake. Common in wet soil or shallow water. Native.
Mimulus alatus Ait. Infrequent around swamps and lakes. Native.
Pedicularis canadensis L. Local in moist open sandy loam soil. Native.
Penstemon australis Small. Frequent in various open mixed and pinewoods and clearings. Native.
Scoparia dulcis L. Infrequent in open sandy loam soils. Native.
Seymeria cassioides (Walter) Blake. Occasional in open upland woods. Native.
Seymeria pectinata Pursh. Occasional in upland mixed woods. Native.
Verbascum thapsus L. Rare at garbage dumps. Introduced.
Veronica arvensis L. Occasional in fields and lawns. Native.
Veronica peregrina L. Infrequent in moist open areas. Native.

SELAGINELLACEAE

Selaginella apoda (L.) Spring. Infrequent in sand along streams. Native.

SOLANACEAE

Datura stramonium L. Rare at garbage dumps. Introduced.
Lycopersicon esculentum Miller. Occasional in disturbed areas. Introduced.
Petunia x *atkinsiana* D. Don ex Loudon. Occasional escape from cultivation. Introduced.
Physalis angulata L. Frequent in cultivated ground. Native.
Physalis pubescens L. Infrequent in cultivated soil. Native.
Physalis virginiana Miller. Occasional in disturbed places. Native.
Solanum americanum Miller. Occasional in open deciduous woods and various waste places. Native.
Solanum carolinense L. Occasional in a variety of disturbed habitats. Native.
Solanum nigrum L. Infrequent in fields and at wood borders. Native.
Solanum sisymbriifolium Lam. Rare in old fields. Introduced.

SPARGANIACEAE

Sparganium americanum Nutt. Infrequent or frequent in shallow water of ponds and lakes. Native.

STERCULIACEAE

Melochia corchorifolia L. Common in cultivated fields. Introduced.

STYRACACEAE

Halesia diptera Ellis. Frequent in ravines. Native.
Styrax americana Lam. Occasional in wet woods and around lakes and swamps. Native.
Styrax grandifolia Ait. Frequent in ravines. Native.

SYMPLOCACEAE

Symplocos tinctoria (L.) L'Her. Frequent in mixed woods. Native.

TAXODIACEAE

Taxodium distichum (L.) Richard. Common in cypress-tupelo swamps. Native.

THEACEAE

Stewartia malacodendron L. Infrequent in ravines. Native.

TILIACEAE

Tilia caroliniana Miller. Frequent in ravines. Native.

ULMACEAE

Celtis laevigata Willd. Occasional in alluvial woods. Native.
Celtis tenuifolia Nutt. var. *georgiana* (Small) Fern. & Schubert. Occasional in open upland

mixed woods. Native.
Planera aquatica (Walter) J. F. Gmelin. Occasional in shallow water or about lakes and swampy woods. Native.
Ulmus alata Michx. Frequent in mixed woods. Native.
Ulmus americana L. Occasional in low woods. Native.
Ulmus rubra Muhl. Infrequent or rare in ravines. Native.

UMBELLIFERAE

Apium leptophyllum (Pers.) F. Mueller. Occasional in moist open areas. Native.
Centella asiatica (L.) Urban. Occasional in moist sandy loam or shallow water. Native.
Chaerophyllum tainturieri Hooker. Frequent along roads and about dwellings. Native.
Daucus carota L. Infrequent along roads. Introduced.
Eryngium prostratum Nutt. Infrequent in open wet places. Native.
Eryngium yuccifolium Michx. (Incl. *E. synchaetum* (Gray) Rose). Frequent in open pinewoods. Native.
Hydrocotyle umbellata L. Occasional in shallow water of ponds. Native.
Hydrocotyle verticillata Thunb. Infrequent in shallow water of lakes. Native.
Oxypolis filiformis (Walter) Britt. Infrequent in open wet areas. Native.
Oxypolis rigidior (L.) Raf. Infrequent in bays and marshy places. Native.
Ptilimnium capillaceum (Michx.) Raf. Occasional in ditches and other open wet soils. Native.
Sanicula canadensis L. Infrequent in mixed woods. Native.
Sanicula smallii Bicknell. Frequent or infrequent in ravines and low woods. Native.
Thaspium barbinode (Michx.) Nutt. Infrequent in ravines and low woods. Native.
Thaspium trifoliatum (L.) Gray var. *flavum* Blake. Infrequent in mixed woods and ravines. Native.
Trepocarpus aethusae Nutt. Local along Leaf River. Native.

URTICACEAE

Boehmeria cylindrica (L.) Swartz. Frequent in swamps, ditches, and around lakes and ponds. Native.
Laportea canadensis (L.) Weddell. Occasional and local in ravines and low woods. Native.
Pilea pumila (L.) Gray. Occasional in ravines and low woods. Native.

VALERIANACEAE

Valerianella radiata (L.) Dufr. Common along roads. Native.

VERBENACEAE

Lantana camara L. Infrequent escape from cultivation or persisting around old homesites. Introduced.
Callicarpa americana L. Common the upper slopes of ravines and in upland woods. Native.
Verbena bonariensis L. Infrequent or rare along roads. Introduced.
Verbena brasiliensis Vellozo. Common in a variety of disturbed habitats. Introduced.
Verbena canadensis (L.) Britt. Infrequent in dryish woods. Native.
Verbena carnea Medicus. Infrequent in upland mixed woods. Native.
Verbena halei Small. Frequent along roads and trails. Native.
Verbena rigida Sprengel. Local in dry open places. Introduced.
Verbena tenuisecta Briquet. Common along roads and in other open sandy sites. Introduced.
Verbena urticifolia L. Infrequent or rare in disturbed low woods. Native.

VIOLACEAE

Viola esculenta Ell. Infrequent in moist pinewoods. Native.
Viola floridana Brainerd. Rather common in ravines and low woods. Native.
Viola palmata L. Occasional in ravines. Native.
Viola papilionacea Pursh. Infrequent in open disturbed areas. Native.
Viola pedata L. Occasional in upland mixed woods. Native.
Viola primulifolia L. Frequent in moist sandy soils or muck about ponds, swamps, and in wet ditches. Native.
Viola rafinesquii Greene. Frequent along roads and in fields. Native.
Viola triloba Schweinitz. Occasional in ravines and low woods. Native.

Viola walteri House. Common in ravines and other mesic woods. Native.

VISCACEAE

Phoradendron serotinum (Raf.) M. C. Johnston. Frequent on a variety of deciduous trees. Native.

VITACEAE

Ampelopsis arborea (L.) Koehne. Frequent about swamps, lakes, and various other wet areas. Native.

Ampelopsis cordata Michx. Infrequent and local along railroad. Native.

Parthenocissus quinquefolia (L.) Planchon. Common in various mesic woodland habitats. Native.

Vitis aestivalis Michx. var. *argentifolia* (Munson) Fern. (Incl. *V. bicolor* LeConte). Frequent along stream banks and in low woods. Native.

Vitis cinerea Engelm. ex Millardet. Occasional along streams and in low woods. Native.

Vitis rotundifolia Michx. Common in a variety of woodland habitats ranging from moist to dry. Native.

Vitis vulpina L. Infrequent in low woods and along streams. Native.

XYRIDACEAE

Xyris caroliniana Walt. Infrequent in moist pine-flatwoods. Native.

Xyris difformis Chapm. Occasional at the borders of ponds and lakes. Native.

Xyris fimbriata Ell. Frequent in sand or mud about lakes and in wet ditches. Native.

Xyris iridifolia Chapman. Frequent at the borders of ponds and in wet ditches. Native.

Xyris jupicai Richard. Locally abundant in moist or wet sand in open disturbed places. Native.

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CHROMOSOME NUMBERS OF GYPSOPHILIC PLANT SPECIES OF THE CHIHUAHUAN DESERT

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This reports original chromosome counts for some dicotyledon species which occur on or are associated with gypsum soils in the Chihuahuan Desert region of North America. Many taxa are absolutely restricted to gypsum while others may also grow on surrounding non-gypsum habitats (Johnston, 1941; Waterfall, 1946). These obligate gypsophiles and facultative gypsophiles include species that constitute unique gypsum floras of the Chihuahuan Desert and elsewhere in western United States and northern Mexica (Powell and Turner, 1975).

The chromosome numbers presented herein were accumulated since 1969 when a chromosomal survey of gypsophilic species was initiated. Major objectives of the chromosomal studies were to compare the percentages of polyploid species on gypsum and non-gypsum substrates and to evaluate the polyploid percentage in the entire Chihuahuan Desert flora. Elsewhere we report (Powell and Sloan, 1977) that the gypsum floras comprise fewer polyploids (17.8%) than non-gypsum vegetation (32.7%), and we calculated an overall polyploid percentage of 30.2 for the Chihuahuan Desert flora. Table 1 presents a large portion of the counts that have contributed to the percentages. A limited number of other counts for gypsophilic taxa have been reported by Turner (1972a, 1972b, 1972c, 1973a, 1973b), Turner, Powell and Watson (1973), Bacon (1974a, 1974b), and a few other workers. We hope eventually to increase the number of counts for gypsophilic and non-gypsophilic species of the Chihuahuan Desert and therefore to refine the accuracy of polyploid percentages in the edaphic-floras. Several hundred species of about 150 genera and 50 families have been estimated to occur on gypsum outcrops of the Chihuahuan Desert. Chromosome numbers are known for about 125 species, about 55 genera and about 25 families, of which 78 species representing 54 genera and 17 families are presented in Table 1.

Information regarding previous reports for the species listed in Table 1 can be found in the chromosome number indexes (Darlington and Wylie, 1956; Cave, 1956-64; Ornduff, 1965-1967; Moore, 1967-1972; Federov, 1969) and other recent literature. Therefore not all of the taxa are commented upon in discussion.

Buds for meiotic analyses were fixed in Modified Carnoy's Solution

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(4 : 3 : 1), and chromosomes were stained with acetocarmine during application of standard squash techniques (Turner and Johnston, 1961). Vouchers are deposited at SRSC, TEX, or US. In Table 1 collection numbers preceded by *P* are by Powell, *Sl* are by Sloan, *Si* are by Sikes, *O* are by Olsen, *Tu* are by Turner, and *To* are by Tomb.

Table 1 reflects the predisposition of certain families, genera, and species to gypsum habitats. Our observations of gypsum vegetation encourage us to draw conclusions about the most prominent families on the unusual substrate, even though this is not necessarily revealed through the taxa for which we present chromosomal data. In terms of number of genera and species, the families most prominently represented on gypsum habitats include Asteraceae, by far the largest, and Cruciferae, Hydrophyllaceae, Boraginaceae, Gramineae, Loasaceae, and Nyctaginaceae. The Nyctage family is not represented in Table 1 because we have not been able to obtain unequivocal chromosome counts for any of its gypsophilic members. Families perhaps less prominent but characteristic on gypsum exposures are Euphorbiaceae, Chenopodiaceae, Leguminosae, Caryophyllaceae, Zygophyllaceae, Onagraceae, Malvaceae, Frankeniaceae, and Amaranthaceae. As suggested in Table 1 certain gypsophilic families and genera contain more polyploid or aneuploid taxa than others. For example, in Asteraceae we have calculated ca. 10% polyploidy for the gypsophilic species, while ca. 27% polyploidy was found for the non-gypsophilic species (data in Table 1, and published elsewhere). Our analysis of the chromosome number reports for Euphorbiaceae by Urbatsch et al. (1975) revealed ca. 60% polyploidy for both the gypsophilic and the non-gypsophilic species of this family in the Chihuahuan Desert region. Eventually we hope to draw conclusions regarding the chromosomal evolution of gypsophilic taxa, but as yet sufficient data are not available to warrant such a discussion.

Sesuvium verrucosum ($n = 8$) occurs in gypseous and non-gypseous, saline habitats and thus the taxon should be regarded as a facultative gypsophile, or perhaps more accurately as a halophytic gypsophile, according to the terminology proposed by Johnston (1941) to denote those gypsophilic taxa that can tolerate concentrations of salts and alkali.

Chromosome numbers are listed for 50 species of Asteraceae, easily the phylad with the most gypsophilic taxa. Most of these species (Table 1) are either dwarf shrubs (19 spp.) or herbaceous perennials (18 spp.), life forms which predominate on gypsum exposures. Large shrubs or trees and annuals are less common on gypsum, although annual facultative gypsophiles are more numerous.

Dicranocarpus parviflorus ($n = 10$) is one of the few annuals that seemingly has an absolute requirement for gypsum. The species ranges throughout most of the Chihuahuan Desert, exhibits considerable exomorphic variability, particularly in fruit characters, but is not known to vary in chromosome number (Turner and Johnston, 1961; Table 1). *Dyssodia acerosa* ($n = 8$) is one of the many facultative gypsophiles that does not exhibit

chromosomal (except $n = 13$ in some non-gypsum habitats) or superficial morphological variability whether growing on gypseous or non-gypseous substrates. High (1974) has demonstrated that cryptic ecotypic differentiation does occur in populations of facultative gypsophiles, and that subtle genetic differences have evolved in some isolated populations of obligate gypsophiles, but studies of this sort are generally lacking for gypsophilic vegetation (Powell and Turner, 1975; Parsons, 1975).

Of the five species of *Flaveria* ($x = 18$) reported in Table 1, only *F. anomala* is considered to be an obligate gypsophile. The other species are commonly found in mixed gypsum-saline habitats.

Turner (1972c) reported tetraploid counts ($n = 34$) for *Gaillardia multiceps* var. *microcephala*, one of the relatively few polyploid gypsophiles. In Table 1 we also list a hexaploid count ($n = 51$) for one population of var. *microcephala*. *Gaillardia* sp. is an undescribed entity seemingly restricted to gypsum in the area of Chihuahua indicated by the localities in Table 1.

The collections of *Machaeranthera* cf. *pinnatifida* ($n = 4,8$), all from "pure" gypsum or gypseous substrates (Table 1) are superficially similar to members of this taxon ($n = 4,8$) found on non-gypseous soils. As stated earlier, the occurrence of facultative gypsophiles such as *Machaeranthera* is possibly correlated with edaphic adaptation, but it has been difficult to detect.

Pseudoclappia arenaria was reported earlier (Powell and Turner, 1963) as $n = 18\pm1$, and our present count (Table 1) is also not unequivocal. A positive number is difficult to ascertain because the chromosomes are small, heteromorphic, univalents or fragments may be present, and one or more bivalents tend to separate early. Although *Pseudoclappia* watsonii is listed as $n = 19$, the chromosome number of this taxon also needs verification.

The species of *Sartwellia*, all $n = 18$ (Table 1), are exclusively gypsophilous, with the possible exception of *S. puberula* which occasionally grows in soils that are weakly or questionably gypseous.

Any distributional or taxonomic significance for the diploid ($n = 11$) and tetraploid ($n = 22$) populations of *Thelesperma megapotamicum* is not immediately apparent. Mostly tetraploid and a few diploid populations of this species also occur on non-gypseous soils (Powell and Sloan, in preparation). The gypsophilic and non-gypsophilic populations are not consistently distinguishable except that gypsophiles in Texas occasionally more closely resemble the Mexican *T. ramosius* ($n = 11$) than other *T. megapotamicum*.

The chromosome number obtained for *Petalonyx crenatus* ($n = 22$) differs from the $n = 23$ that was determined for the other four species of the genus (Davis and Thompson, 1967). *Petalonyx crenatus*, a Coahuila endemic on gypsum, is isolated from the other species which are widespread in the western North America deserts, and so its chromosomal difference is not surprising.

The count listed for *Tetraclea coulteri* ($n = 21$) is a first report for the

genus which has been placed variously in the Verbenaceae and in the Labiateae. In both families there are species with $x = 7$, and both families exhibit taxa with an array of base numbers which could give rise to $n = 21$. The chromosome number of *Tetraclea* may be of value in placing the genus if related genera were studied cytologically.

A chromosome number for the monotypic Mexican endemic *Sericodes greggii* (n = ca. 15) is reported in Table 1. The approximate count was obtained from but three cells which revealed small, light-staining chromosomes, but perhaps it will contribute toward understanding the origin of the related genus *Larrea* ($x = 13$), a North American-South American disjunct (Porter, 1974).

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Table 1. ORIGINAL CHROMOSOME COUNTS FOR OBLIGATE AND FACULTATIVE PLANT GYPSOPHILES OF THE CHIHUAHUAN DESERT

Taxon	Gametic No.	Locality
AIZOACEAE		
**Sesuvium verrucosum* Raf.	8	TEX: Reeves Co. Toyah Lake 4 mi SE Pecos, *P 1911*; 1 mi N of Pecos, *Sl 79*.
	8	MEX: Coah. 12 mi E of Cuatro Cienegas, *P* & *Tu 2279*.
ASTERACEAE		
Aster subulatus Michx.	5	TEX: Culberson Co. 20 mi W of Orla, *Sl 88*.
**Baccharis cf. wrightii* Gray	9[a]	TEX: Brewster Co. near Terlingua *Tu* s.n.
Bahia absinthifolia Benth var. *dealbata* Gray	12	TEX: Culberson Co. 26 mi W of Orla, *Sl 100*; Reeves Co., 6 mi W of Orla, *Sl 53*.

† = seemingly obligate gypsophile
X = halophytic gypsophile
* = previously unreported chromosome number
[a] $n = 9$ II + 1 I, $n = 9$ II, or $n = 8$ II + 1 III.
[b] $n = 9$ II + 0-3 B chromosomes.
[c] *P 2390*, $n = 8$ II plus 2 fragments
[d] frequent multivalents and univalents
[e] *P*, *T*, *Si 2458*, with occasional multivalents
[f] with early dividing, heteromorphic bivalents, 1-2 fragments, one multivalent, could be $n = 17$ II + 1 I, $n = 18$ II, or $n = 19$ II.
[g] possibly $n = 18$ II + 1 I.
[h] consistently $n = 18$ II + 2 rings of four
[i] seemingly apomictic, bivalents rarely observed.

†*Bartlettia scaposa* Gray	11	TEX: Hudspeth Co. just E of Tommy's Town, *P 2418*.
**Brickellia sp.*	9[b]	MEX: Chih. 5 mi W of Presa Granero, *P* & *Tu 2027*.
Erigeron pinkavii Turner	9	MEX: Coah. 18 mi E of Cuatro Cienegas, *P* & *Tu 2270*.
†*Dicranocarpus parviflorus* Gray	10	MEX: N. L. 7.5 mi S of San Roberto junct., *P* & *To 2560*; S. L. P., 28 mi S of Matehuala, *P* & *To 2581*; Zac., 8.5 mi NE of Concepción del Oro, *P* & *To 2598*. TEX: Culberson Co. 26 mi W of Orla, *Sl 111*.
Dyssodia acerosa DC.	8[c]	MEX: Chih. 8.1 mi W of Camargo, *P* & *To 2650*. TEX: Brewster Co. near Terlingua, *P 2390*; Ward Co., 5 mi S of Pyote, *Sl 69*.
†*Ericamera triantha* (Blake) Shinners	9	MEX: 4 mi NW of Cuatro Cienegas, *P* & *Tu 2281*, 5 mi W of Cuatro Cienegas, *P* & *Tu 2293*.
Eupatorium cf. greggii Gray	10	MEX: Coah. 8 mi S of Cuatro Cienegas, *Si*, O, & *P 849*.
Flaveria anomala B. L. Robins	18	MEX: Coah. 26.5 mi N of Concepción del Oro, *P* & *To 2599*; N. L. 7.5 mi S of San Roberto junct., *P* & *To 2559*; 34.4 mi S of San Roberto junct., *P* & *To 2566*; S. L. P. 1 mi N of Matehuala, *P* & *To 2568*; *Si*, O & *P 818*; 28 mi S of Matehuala, *P* & *To 2579*; Zac. 8.5 mi NE of Concepción del Oro, *P* & *To 2594*.
Flaveria chloraefolia Gray	18	MEX: Coah. 12 mi E of Cuatro Cienegas, *P* & *Tu 2278*. TEX: Culberson Co. 20 mi W of Orla, *Sl 73*; Reeves Co. ca. ½ mi E of Toyahvale, *P 2799*.
Flaveria oppositifolia (DC.) Rydb.	18	MEX: Dgo. 9 mi N of Dgo-Zac. border, *Si*, O, & *P 831*; N. L. 45-46 mi SE of Saltillo, *P* & *To 2551*; ca. 44 mi S of Saltillo, *Si*, O, & *P 817*; 14-15 mi S of San Roberto junct., *P* & *To 2561*; Zac. 55 mi NE of junct. 49-54, *P* & *To 2593*.
Flaveria palmeri J. R. Johnst.	18	MEX: Coah. 39 mi N of San Pedro, *P* & *To 2611*; just W of Cuatro Cienegas, *P* & *To 2621*; 67 mi SW of Cuatro Cienegas, *P* & *To 2631*; near Matamoros, *Si*, O, & *P 838*; 15 mi E of Cuatro Cienegas, *Si*, O, & *P 851*.
Flaveria trinervia (Spreng.) C. Mohr	18	MEX: Chih. 3 mi W of Camargo, *P* & *To 2658*; 2-3 mi N of Meoqui, *P* & *To 2660*; S. L. P. ca. 1 mi N of Matehuala, *Si*, O, & *P 819*. TEX: Reeves Co., 1 mi N of Pecos, *P 2204*; Williamson Co., ca. 1 mi N of Liberty Hill, *Si 812*.
†*Gaillardia multiceps* Greene var. *microcephala* Turner	34[d]	NEW MEX: Chaves Co. 1-4 mi N of Dexter, *P 2794*.
	51[d]	TEX: Ward Co. 6 mi S of Pyote, *P 1876*.

Gaillardia pinnatifida Torr.	17	TEX: Culberson Co. 8-15 mi W of Orla, *Sl 26.*
†**Gaillardia turneri* Averett & Powell	17	MEX: Chih. 14 mi W of Presa Granero, *P* & *Tu 2025*; 1.7 mi S of Placer de Guadalupe, *P* & *Tu 2055.*
Gutierrezia microcephala (DC.) Gray	4	TEX: Culberson Co. 20 mi W of Orla, *Sl 90*; Ward Co. 7 mi S of Pyote, *Sl 83.*
Gutierrezia cf. texana (DC.) T. & G.	4	MEX: N. L. between Monclova and Monterrey, *P* & *Tu 2295.*
Gutierrezia sp.	16	TEX: Reeves Co. 7.4 mi E of Pecos, *Sl 40.*
Haploesthes greggii Gray var. *greggii*	18	MEX: Coah. ca. 5 mi W of Oballos, *P* & *Tu 2252*; 1 mi N of Allende, *P* & *Tu 2725*; N. L. Portrero Chico, *P* & *Tu 2331*; near Espinoza *P* & *Tu 2322.*
Haploesthes greggii var. *texana* (Coult.) I. M. Johnst.	18	NEW MEX: Socorro Co. 48.5 mi E of San Antonio, *P 2529.* TEX: Crane Co. near junct. 1053-329, *P 2777*; Crosby Co. near White River Lake Dam, *P 2787*; Ward Co., just S of Pyote, *P 1899*; 6 mi E of Grandfalls, *P 2358.*
Haploesthes greggii cf. var. *texana* (Coult.) I. M. Johnst.	18	TEX: Brewster Co. 1.5 mi W of Terlingua, *High* & *High 99*; Val Verde Co. just N of Langtry, *P 2678.*
[x]*Haploesthes robusta* I. M. Johnst.	18	MEX: Coah. 3-4 mi SW of Cuatro Cienegas, *P* & *To 2619.*
†*Hymenoxys odorata* DC.	15	MEX: N. L. 45-46 mi SE of Saltillo, *P* & *To 2554.*
Isocoma coronopifolia (Gray) Greene	6	MEX: ca. 15 mi E of Cuatro Cienegas, *P* & *Tu 2271.*
Isocoma wrightii (Gray) Rydb.	6	TEX: Culberson Co. 16 mi W of Orla, *Sl 57*; 29 mi N of Van Horn, *P 2788*; Reeves Co. 1 mi N of Pecos, *Sl 58.*
Isocoma wrightii (Gray) Rydb.	ca.12	TEX: Hurspeth Co. ca. 1 mi E of Tommy's Town, *P 2791.*
Leucelene ericoides (Torr.) Greene	8	TEX: Culberson Co. 34 mi N of Van Horn, *P 2395.*
Machaeranthera cf. *pinnatifida* (Hook.) Shinners	4	MEX: Coah. 35.5 mi N of Concepción del Oro, *P* & *To 2601*; 67 mi SW of Cuatro Cienegas, *P* & *To 2632*; 45 mi SW of Cuatro Cienegas, *Tu 6003.* Chih. 11.5 mi W of Camargo, *P* & *To 2641*; 8.1 mi W of Camargo, *P* & *To 2651.* N. L. Garcia Caves, *Tu 6378.* TEX: Culberson Co. 36 mi N of Van Horn, *P 1943*; Reeves Co. 4 mi W of Orla, *Sl 45*; 7 mi SE of Pecos, *Sl 117.*
Machaeranthera cf. *pinnatifida* (Hook.) Shinners	8[e]	MEX: Chih. 20 mi W of Ojinaga, *P*, *Tu*, & *Si 2458.*

Machaeranthera tanacetifolia (H.B.K.) Nees	4	TEX: Reeves Co. 7.4 mi SE of Pecos, *Sl 35*.
Melampodium leucanthum T. & G.	10	TEX: Brewster Co. near Terlingua, *P 2388*; Jeff Davis Co. Near Brack's Tunnel, *Si* & *Babcock 312*; Reeves Co. 6 mi W of Orla, *Sl 50*.
Perityle parryi Gray	17	MEX: Chih. 6 mi W of Presa Granero, *P* & *Tu 2030*; *2049*.
†*Perityle vaseyi* Coult.	17	MEX: Chih. 6.5 mi S of Ojinaga, *P* & *Tu 2002*. TEX: Brewster Co. 1.5 mi W of Terlingua, *High* & *High 97*.
[x]*Pseudoclappia arenaria* Rydb.	18[f]	TEX: Reeves Co. 1 mi N of Pecos *P 1907*; *2142*.
*†*Pseudoclappia watsonii* Powell & Turner	ca. 19[g]	TEX: Hudspeth Co. just E of Tommy's Town, *P 2415*.
Psilostrophe cf. tagetina (Nutt.) Greene	16	TEX: Culberson Co. 25.6 mi W of Orla, *Sl 77*; 34 mi N of Van Horn, *P 2394*; Reeves Co. 7.4 mi SE of Pecos, *Sl 36*; Ward Co. 6 mi E of Grandfalls, *P 2368*.
†*Sartwellia flaveriae* Gray	18	NEW MEX: Chaves Co. 1-4 mi N of Dexter, *P 2796*. TEX: Crane Co. 13 mi E of Grandfalls, *Meyer 30*; Culberson Co. 45 mi N of Van Horn, *P 2122*; Reeves Co., 8 mi W of Orla, *Sl 31*; 4 mi W of Orla, *Sl 46*; 5 mi W of Orla, *P 1917*.
†*Sartwellia mexicana* Gray	18	MEX: Coah. 0.5 mi S of Est. Hermanas, *P* & *To 2548*; S. L. P. 1 mi N of Matehuala, *P* & *To 2570*; 28 mi S of Matehuala, *P* & *To 2580*; Zac. 8.5 mi N of Concepción del Oro, *P* & *To 2595*; 55 mi NE of junct. 49-54, *P* & *To 2592*.
†*Sartwellia puberula* Rydb.	18	MEX: Coah. 61 mi W of Saltillo, *P* & *To 2609*; 40 mi N of Sal Pedro, *P* & *To 2613*; 38 mi SW of Cuatro Cienegas, *P* & *To 2626*; 68 mi SW of Cuatro Cienegas, *P* & *To 2634*; 67 mi N of San Pedro, *Si*, *O*, & *P 843*; Chih. 12 mi W of Camargo, *P* & *To 2635*; ca. 27 mi NE of El Morrión, *P* & *To 2666*.
†**Sartwellia gypsophila* Powell & Turner	18	MEX: Chih. ca. 5 mi W of Presa Granero, *P 2536*.
†**Senecio warnockii* Shinners	20	TEX: Culberson Co. 20 mi W of Orla, *Sl 93*.
Stephanomeria pauciflora (Torr.) A. Nels.	8	MEX: Chih. 6.5 mi S of Ojinaga, *P* & *Tu 2003*. TEX: Presidio Co. NW of Candelaria, *High* & *Gallagher 79*.
Strotheria gypsophila Turner	8	MEX: N. L. 15.7 mi S of San Roberto junct., *P* & *To 2565*.
Thelesperma longipes Gray	10	TEX: Brewster Co. near Terlingua, *P 2385*.
Thelesperma megapotamicum (Spreng.) Kuntz.	11	TEX: Culberson Co. 22 mi W of Orla, *Sl 96*.
Thelesperma megapotamicum (Spreng.) Kuntz.	ca. 11	TEX: Ward Co. 7.6 mi S of Pyote, *Sl 85*.
Thelesperma megapotamicum		

(Spreng.) Kuntz.	22^{h}	MEX: Coah. 1 mi N of Allende, *P* & *Tu 2726*. NEW MEX: Chaves Co. 1-4 mi N of Dexter, *P 2795*.
Thelesperma megapotamicum (Spreng.) Kuntz.	ca. 22	MEX: Chih. 15 mi SE of El Morrión, *P 2432*. TEX: Culberson Co. 34 mi N of Van Horn, *P 2404*; Reeves Co. 7.4 mi SE of Pecos, *Sl 37*; *114*; *116*.
†*Thelesperma ramosius* Blake	11	MEX: Coah. 1 mi S of Est. Hermanas, *P* & *Tu 2264*.
†*Thelesperma scabridulum* Blake	12	MEX: Coah. 35.5 mi N of Concepción del Oro, *P* & *To 2600*.
Varilla mexicana Gray	18	MEX: Coah. Las Delicias, *P* & *Tu 2698*.
Verbesina encelioides (Cav.) Gray	17	TEX: Reeves Co. 7.4 mi SE of Pecos *Sl 43*; Ward Co., 5 mi S of Pyote, *Sl 67*.
†*Xylorhiza wrightii* (Gray) Greene	6	MEX: Chih. 10.4 mi S of Ojinaga, *P* & *Tu 2017*.
BORAGINACEAE		
†**Coldenia hispidissima* (Torr.) Gray	9	TEX: Culberson Co. 36 mi N of Van Horn, *P 1939*; Reeves Co. 5 mi W of Orla, *P 1914*; Ward Co. 6 mi E of Grandfalls, *P 2355*.
CARYOPHYLLACEAE		
†**Drymaria cf. lyropetala*	12	MEX: N. L. between Monclova and Monterrey *P* & *Tu 2304*.
†**Drymaria sp.*	12	MEX: Chih. ca. 7 mi NW of Presa Granero, *P 2433*.
CHENOPODIACEAE		
^{x}**Suaeda suffrutescens* Wats.	ca. 9	TEX: Reeves Co. 4 mi W of Orla, *Sl 47*.
CRUCIFERAE		
Lepidium montanum Nutt.	16	NEW MEX: Socorro Co. 48.5 mi E of San Antonio, *P 2531*. TEX: Culberson Co., 20 mi W of Orla, *Sl 91*; 34 mi N of Van Horn, *P 2400*; Hudspeth Co., W of Guadalupe Mts., *P 2409*; Reeves Co., 8 mi W of Orla, *Sl 23*; 7.4 mi SE of Pecos, *Sl 41*; Ward Co., 5 mi S of Pyote, *Sl 62*; 6 mi E of Grandfalls, *P 2357*.
Nerisyrenia camporum (Gray) Greene	9	MEX: Chih. 11.5 mi W of Camargo, *P* & *To 2640*.
Nerisyrenia camporum (Gray) Greene	ca. 18	NEW MEX: Doña Ana Co. E. side of San Andres Mts., *Spellenberg* & *Todsen 2644*.
†*Nerisyrenia gypsophila* Bacon	9	MEX: Chih. near Presa Granero *P* & *Tu 2026*.
†*Nerisyrenia linearifolia* (Wats.) Greene	9	TEX: Culberson Co., 20 mi W of Orla, *Sl 74*; 34 mi N of Van Horn, *P 2397*.
†*Nerisyrenia linearifolia* (Wats.) Greene	18	TEX: Reeves Co., 7.4 mi SE of Pecos, *Sl 39*; Ward Co. 5 mi S of Pyote, *Sl 63*.

**Streptanthus carinatus* Wright	14	MEX: Chih. 20 mi W of Ojinaga, *P*, *Tu*, & *Si 2457*.
EUPHORBIACEAE		
Croton dioicus Cav.	14	TEX: Ward Co. 6 mi E of Grandfalls *P 2372*.
Croton dioicus Cav.	21	TEX: Culberson Co. 26 mi W of Orla, *Sl 99*.
GENTIANACEAE		
†**Centarium sp.*	ca. 401	MEX: Chih. 27 mi NE of El Morrión, *P*, *Tu*, & *Si 2487*.
HYDROPHYLLACEAE		
Nama hispidum Gray	7	MEX: Chih. 20 mi W of Ojinaga, *P*, *Tu*, & *Si 2460*.
†**Phacelia gypsogenia* I. M. Johnst.	11	MEX: Chih. ca. 6 mi SE of El Morrión, *P* & *Tu 2689*.
†**Phacelia cf. integrifolia* Torr.	11	TEX: Brewster Co., near Terlingua, *P 2384*; Presidio Co. ca. 10 mi W of Candelaria, *High* & *Gallagher 90*; Reeves Co. 7 mi SE of Pecos, *Sl 115*.
LINACEAE		
**Linum puberulum* (Engelm.) Heller	15	TEX: Ward Co. 7 mi S of Pyote, *Sl 120*.
LOASACEAE		
Eucnide lobata (Hook.) Gray	21	MEX: N. L. Puerto Chico, near Monterrey, *P* & *Tu 2332*.
†*Mentzelia humilis* (Gray) Darl.	10	TEX: Culberson Co. 34 mi N of Van Horn, *P 2399*; Reeves Co. 6 mi W of Orla, *Sl 49*; 5 mi W of Orla, *P 1912*.
Mentzelia multiflora (Nutt.) Gray subsp. *multiflora*	9	TEX: Reeves Co. 7.4 mi SE Pecos, *Sl 34*.
Mentzelia savicola H. J. Thoms. & Zavor.	10	MEX: Chih. 27 mi NE of El Morrión, *P*, *Tu*, & *Si 2498*; 8.1 mi W of Camargo, *P* & *To 2647*.
Mentzelia sp.	10	TEX: Hudspeth Co. 22 mi S of Tommy's Town, *P 2422*.
†**Petalonyx crenatus* Gray ex S. Wats.	22	MEX: Coah. 2 mi off hwy. toward Las Delicias, *P 2697*.
MALVACEAE		
†**Sphaeralcea subhastata* Coult.	10	TEX: Culberson Co. 34 mi N of Van Horn, *P 2396*; Ward Co. 5 mi S of Pyote, *Sl 60*.
ONAGRACEAE		
Calylophus hartwegii Benth. (Raven) subsp. *filifolius* (Eastw.) Towner & Raven	7	TEX: Culberson Co. 34 mi N of Van Horn, *P 2405*; Reeves Co. 6 mi W of Orla, *Sl 52*.

SCROPHULARIACEAE		
**Castilleja sp.*	12	MEX: N. L. between Monclova and Monterrey, *P & Tu 2306*; Chih. 15 mi SE of El Morrión, *P 2435*.
SOLANACEAE		
Chamaesaracha villosa Rydb.	12	MEX: Chih. 20 mi W of Ojinaga, *P*, *Tu*, & *Si 2465*.
Physalis hederaefolia Gray	12	MEX: N. L. between Monclova and Monterrey, *P & Tu 2307*.
VERBENACEAE		
**Tetraclea coulteri* Gray	21	MEX: Coah. ca. 30 mi NE of San Pedro, *P & Tu 2690*.
ZYGOPHYLLACEAE		
†**Sericodes greggii* Gray	ca. 15	MEX: Coah. ca. 54 mi N of San Pedro, *Si*, *O*, & *P 842*.
Larrea tridentata (DC.) Cov.	13	TEX: Hudspeth Co. 1 mi S of Tommy's Town, *P 1560*.

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NOTES

NEW AND VERIFIED ADDITIONS TO THE NEBRASKA VASCULAR FLORA. II.—In a previous paper Churchill (Sida 6: 116-117. 1975) reported 7 new and 1 verified vascular taxa for Nebraska. Further field and herbarium work during 1975 has produced additional new records for Nebraska. All specimens cited are deposited at the Nebraska State Herbarium (NEB) with a duplicate set of the Churchill and Shildneck collections deposited at the University of Kansas (KANU). New taxa for the state are marked with an asterisk (*).

* *Juncus effusus* L. Richardson Co.: NW. of Verdon (Sec. 34, T3N, R15E), in shallow water of roadside ditch, 26 June 1975, *Shildneck C-7624.* This extends the range of this rush north from Kansas and Missouri.

* *Aristida purpurascens* Poir. Jefferson Co.: 5 miles S. of Fairbury on Hwy 15 & just E., eroded sandstone ravine, 1 October 1975, *Churchill 6811.* This extends the range north from Kansas.

* *Alliaria officinalis* Andrz. Webster Co.: 1 mile S. of Red Cloud, floodplain woods along Republican River, 28 May 1975, *Churchill 5427.* This is the first report for the state of this introduced and naturalized taxon from Europe.

Rorippa austriaca (Crantz) Besser. Cuming Co.: 6 miles SE. of Beemer on Hwy US 275, wet roadside ditch, 31 May 1975, *Churchill 5511.* Stuckey (Sida 4: 279-430. 1972) reported a single collection of this adventive taxon from Europe for Nebraska. Thus, this collection is the second report but the first specimen for the Nebraska State Herbarium.

* *Potentilla plattensis* Rydb. Cheyenne Co.: E. of Potter, wet grassland, 20 June 1953, *Kiener 29423.* This extends the range east from Colorado and Wyoming.

Rosa multiflora Thunb. Jefferson Co.: 5 miles S. of Fairbury on Hwy 15 & just E., on steep banks of shaded sandstone ravine, 1 October 1975, *Churchill 6776.* This is the first verified collection of this Asia rose collected in the wild. Several collections in NEB by J. M. Bates of this taxon are marked with the abbreviation "cult.", but other duplicates of the same number give no indication whether or not they were collected under cultivation.

Desmodium sessilifolium (Torr.) T. & G. Jefferson Co.: 5 miles S. of Fairbury on Hwy 15 & just E., grassy W-facing sandstone bluff, 1 October 1975, *Churchill 6791.* This verifies an earlier collection from Jefferson Co.: Fairbury, 20 July 1891, *Price s. n.* This extends the range north from eastern Kansas.

Hypericum mutilum L. Jefferson Co.: 5 miles S. of Fairbury on Hwy 15 & just E., shaded *Quercus* tributary creek, 1 October 1975, *Churchill 6745.* This verifies two earlier collections from Jefferson Co.: Endicott, 22 August

1893, *Woods & Saunders 2092*; Fairbury, 7 July 1890, *Price s. n.* These collections extend the range north from eastern Kansas.

* *Lobelia inflata* L. Burt Co.: 5 miles S. of Decatur & 1.5 miles W., slope on grazed upland woods, 5 October 1975, *Churchill 6850.* Richardson Co.: Rulo-White Cloud road (NE¼, Sec.26, T1N, R18E), edge of wooded slope next to road, 13 September 1974, *Shildneck C-7151.* Two earlier collections were reported by Winter (An Analysis of the Flowering Plants of Nebraska. Univ. of Nebr. 1936), one specimen was incorrectly identified and the other cultivated. This extends the range east from Iowa and north from Kansas.

I wish to thank Dr. Ronald McGregor for verification of *Rorippa* and *Potentilla.*—*Steven P. Churchill, School of Life Sciences, University of Nebraska, and Division of Botany, University of Nebraska State Museum, Lincoln, Nebraska 68588.*

SARCOSTEMMA CYNANCHOIDES (ASCLEPIADACEAE) IN ARKANSAS —*Sarcostemma cynanchoides* Dcne. is widely distributed from central Mexico to southern Utah and from extreme southern California to about 97 degrees west latitude in Texas and Oklahoma. As interpreted by Holm (Ann. Mo. Bot. Gard. 37: 528. 1950.), this species may be divided into eastern and western subspecies. The eastern subspecies, *S. cynanchoides* subsp. *cynanchoides*, was recently found to occur in Arkansas where it is now known from two localities. One station from the north central part of the state represents an extension of about 275 miles from the previous easternmost collection from near Stillwater, Oklahoma. This collection of Thomas and Reid was distributed under the label of Northeast Louisiana State College, Monroe, as *Cynanchum laeve* (Michx.) Pers., a species superficially resembling *S. cynanchoides* in its climbing habit and cordate leaf shape. The flowers of the two are strikingly different, those of *S. cynanchoides* being much larger, and having a corona of 5 inflated segments. The flowers of *C. laeve* are small, never more than 4 mm in diameter and have a corona of delicate membranous scales. Subsequent to the first draft of this note, Dr. Mahler informed me of a second Arkansas record for *S. cynanchoides.* This collection, made by Demaree, is from western Arkansas and is from a locality nearly halfway between the collection cited above and the Stillwater station. ARKANSAS: Izard County. Cliffs beside White River and railroad tracks, 2 miles west of Croker. 8 August 1970. *R. Dale Thomas & Robin Reid 20640* (MO, SMU). Franklin County. High bottoms of Arkansas River. Common. P.O. Ozark. Elev. 380 ft. 3 Sept. 1966. *Delzie Demaree 54246* (SMU). —*D.L. Spellman, Missouri Botanical Garden, St. Louis, MO. 63110.*

PSILOTACEAE SYMPOSIUM REPRINTS AVAILABLE

The recent symposium entitled "Taxonomic and Morphological Relationships of the Psilotaceae," which was presented during the 1976 AIBS meetings at Tulane University, will be published in the January-March issue of BRITTONIA. This symposium, under the chairmanship of Richard A. White (Duke University) and sponsored by the American Fern Society, the American Society of Plant Taxonomists, and the Pteridological, Paleobotanical, Structural and Systematic Sections of the Botanical Society of America, summarizes the major points of the current controversy surrounding this enigmatic plant group.

Contributors are: David W. Bierhorst (University of Massachusetts), The systematic position of *Psilotum* and *Tmesipteris;* Patricia G. Gensel (University of North Carolina), Morphologic and taxonomic relationships of the Psilotaceae relative to evolutionary lines in early land vascular plants; Donald R. Kaplan (University of California—Berkeley), Morphological status of the shoot systems of Psilotaceae; and Warren H. Wagner, Jr. (University of Michigan), Systematic implications of the Psilotaceae. The set of papers, together with introduction and discussion, will be printed as a unit and become available in April as a separate through the New York Botanical Garden. Copies can be obtained by sending your order, along with $3.00 per copy ($2.50 each in quantities of 30 or more), to: BRITTONIA, New York Botanical Garden, Bronx, NY 10458. No orders will be filled unless accompanied by payment.

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POLLEN EXINE MORPHOLOGY AND ITS ADAPTIVE SIGNIFICANCE[1]

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The contribution of the research papers[2] presented in this symposium, "Systematics and Evolution of Pollen Characters in Angiosperms," could be summarized as the potential gift that new advances in electron microscopy can make to systematics.

I am reminded of an earlier stepping stone in palynological research by Professor G. Erdtman, who developed the acetylosis procedure, a technique that allowed the first concise and intimate view of pollen wall morphology. However much progress in this field we attribute to Professor Erdtman, he in turn told me some time ago that his inspiration in palynology had really been the outcome, the natural evolution, if you will, of the pioneering research of Dr. R. P. Wodehouse, whose drawings of stained pollen grains remain classic examples of what may be accomplished with a minimum of instrumentation and much dedication. This modesty was nevertheless characteristic of a great scientist whose impact on palynology is everlasting, and appropriately this symposium is dedicated to Professor Erdtman's memory.

Let me capsulate the research papers presented to you this morning and add a few remarks of my own on potential adaptive significance of the diversity we have observed.

Recent research by Richard C. Keating (1973) on the Flacourtiaceae using only light microscopy has now been supplemented by both transmission and scanning electron microscopy, greatly enhancing observations of wall structure and grain surface. Keating considers the triaperturate

[1] Summary address, Pollen Symposium, A.I.B.S. meetings, Arizona State University, Tempe, July, 1974.

[2] In sequence of presentation are:

Keating, R. C. 1975 [1976]. Trends of specialization in pollen of Flacourtiaceae with comparative observations of Cochlospermaceae and Bixaceae. Grana 15: 29-49.

Nowicke, J. W. 1975 [1976]. Pollen morphology in the order Centrospermae. Grana 15: 51-77.

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grain, which is typical of many genera in the Flacourtiaceae, primitive. This opinion correlates well with vegetative and floral features, and thus places the family among the more primitive Angiosperms. Therefore, he assigns a basal position to the family in the Violales, for none of the other members of the order shows so primitive a pollen morphology or so little diversity. Of what variation does exist, however, Keating made the important observation that it is not unidirectional in all groups. For example, there is a tendency for near solid tecta to have been derived from finely reticulated tecta, as well as a tendency to form well developed infratectal spaces among both primitive and advanced taxa. These suggest nonhomologous derivations and signal caution to the phylogenist who would base hypotheses on exine characters alone. Here, too, are examples of parallel evolution that again flash caution to those who would interpret like-morphologies invariably as having an immediate, common ancestory.

Keating outlined an interesting microperforate tectal sequence in the Flacourtiaceae from those pollen having numerous micropores and flat tecta to those with micropores clumped into orifices between high ridged tecta. This condition masks a reticulated exine, for if it were true reticulation, the bacula would be organized below the ridges only, which is not the case. This sequence is valuable not only because it suggests an origin of reticulated exines from essentially tectate one, but it emphasizes the wide occurrence of micropores, a subject I shall return to shortly.

An undoubted feature of this symposium is the enormous scope of the papers, perhaps epitomized by the report of Joan W. Nowicke who characterized palynologically 16 families in the Centrospermae. This mass approach to pollen morphology is not one that I am criticizing. Quite the opposite, for I hope we can encourage such studies involving extensive research and synthesis of as many parts of as many organisms as we possibly can in our quest for an understanding of broad evolutionary pathways.

The report by Nowicke is, therefore, possibly a unique feat for shear number of taxa involved, but it is also much more. For example, the finding of spinulose, perforated exines universally in the Centrospermae is perhaps as important a unifying character as the curved embryo or the unique sieve tube plastids now used to distinguish members of this order. Moreover, these new data do not preclude and perhaps even support the inclusion of the Caryophyllaceae and Molluginaceae, which otherwise do not possess betalains, with betalain-possessing families, and, thus, placing in the Centrospermae taxa having either anthocyanins or betalains.

Another significant contribution of her work is finding pollen grains in the Gyrostemonaceae and Achatocarpaceae distinct from those of the Phytolaccaceae. This confirms their separation from the latter, and questions their retention in the Centrospermae. In Nowicke's opinion, the pollen characters of *Theligonum* are sufficiently different from all other

Centrospermae known to suggest, in correlation with sporophytic features, its removal from the order, and perhaps, as suggested by Wunderlich (1971) placed in the Rubiaceae.

These more primitive families served as a springboard for the report by Thomas N. Taylor and Donald A. Levin who surveyed the more advanced Polemoniaceae. They found that grains with colporate and pantoporate apertures predominate, although tropical genera are typically pantoporate. Among former genera they observed a trend from large to small size pollen. Among those with pantoporate pollen, they noted an increase in aperture number with a decrease in pollen size from a tropical genus *(Bonplandia)* to one with strong temperate affinities *(Polemonium)*. These and other data were compatible with a morphological and chromosomal phylogeny proposed by Verne Grant (1959). Some differences exist, however, and these need exploration.

Looking beyond comparative morphology, Taylor and Levin investigated the intriguing question of correlations between, for example, pollen size, which is so variable in the Polemoniaceae, and pollinator. They found a significant relationship between the large pollen transported by bats as well as between much smaller grains pollinated by various insects. They do not believe that these correlates are due to coadaptation directly, but rather to style length in which selection favors pollen size having enough metabolites for pollen tube growth to reach the embryo sac. However, we cannot dismiss the observation that a direct correlation may exist between the large, hexaploid pollen and large flowers of *Cobaea*, and bat pollination due to mechanisms as yet far from understood.

With regard to exine architecture, however, Taylor and Levin saw no apparent association with pollination mechanism and environmental parameters, a point I shall return to subsequently. They concluded that parallel evolution, at least in the Polemoniaceae, remains unidentified in pollen morphology, an interesting possibility in so variable a family palynologically.

The remainder of the symposium was devoted to the highly evolved and palynologically diverse Asteraceae. In his discussion of chicory exines (tribe Lactuceae), A. Spencer Tomb typified the wall structure as echinolophate, that is to say, with elaborate systems of ridges and spines disposed around and between apertures and pseudoapertures. This feature is the outstanding condition of the Lactuceae, for all subtribes recognized possess such grains. Some, but not all, subtribes also have echinate pollen, a much less elaborate spinulous pattern in which the spines are usually scattered over the surface and obvious gaps (lacunae) are absent. Tomb suggested subtribal modifications in classification based on these and other characters of the pollen correlated with morphological and chromosomal data. He also presented the probable evolutionary pathways for these pollen from echinate to echinolophate, from moderate-sized cavea to those exines

without a gap between the sexine and nexine, from tectate, perforate lacunal surfaces to nontectate lacunae, and from large sized grains to those having smaller sizes. These may be unidirectional trends, although some caution is necessary. Via polyploidy, for example, the more evolved, smaller grains could have independently given rise to much larger grains in various subtribes, and these, therefore, would be of more recent origin than the smaller, less ploid grains. Tomb also made this observation while discussing evolutionary direction involving the origin of echinolophate exines, namely, that less elaborate echinate exines may have evolved by reduction from more elaborate ones and that this atavism must not be confused with a single origin. In other words, the echinate condition can be both primitive and advanced.

The second paper on asteraceous pollen was presented by John J. Skvarla as a general survey of research on the tribe Inuleae, a tribe whose pollen exine is much less dramatically elaborate than that of the chicories, but none-the-less intriguing. He recognized two basic pollen types in the Inuleae, the first having simple or ramified bacula usually with abundant infrabaculate micropores (a type clearly related to the Senecioneae and Heliantheae), and the second in which the bacula are very complex having, for example, several levels of internal tecta, but lacking infrabaculate micropores and cavea. The second morphology is characteristic of the subtribe Tarchonantheae, as well as several genera scattered throughout the tribe *(Adenocaulon, Gymnarrhena, Osmites-Osmitopsis)*, a morphology which the author notes is common among the tribe Anthemideae. As a result of this study, Skvarla suggests that much of the infratribal classification of the Inuleae is artificial.

We have observed among these surveys, involving largely comparative morphology of the exine, the substantial value of palynology in systematic studies. Clearly, palynological evidence may be useful in placing taxa of uncertain affinity, of suggesting taxonomic rearrangement, as well as corroborating other lines of evidence in order to establish evolutionary hypotheses.

Exine diversity is extraordinary in the sample we have just observed, illustrating surely the tremendous competence of flowering plants in designing and building these walls. But why, we might ask, have these plants bothered? Are we to assume that what we have observed are but meaningless manifestations; if not, can we recognize that there are adaptive elements at play and that diversity has resulted from selective forces (Heslop-Harrison 1971)? Clues do exist of the adaptive value of pollen wall structure. Basically the wall serves to protect contents from desiccation, it facilitates or permits efficient germination, and it can also be expected to have adaptive roles concerned with dispersal. In relation to these functions, let us examine the most conspicuous feature of the wall so universally stressed during this symposium, the aperture.

Apertures form the preferred paths of exit for the pollen tube, but their function extends beyond providing an escape route. For example, they act as regulators controlling the gain and loss of water. Very briefly, the plates, plugs and granules which cover many apertures consist of typically impermeable exine which can be observed to close on dehydration caused by an infolding of the intine at the aperture site. Imbibing water, however, brings about a gaping of the aperture with the exine being carried apart on the surface of the extended intine or left at the aperture margins. A further aid to this regulation is the so-called pollenkit or lipid of tapetal origin which on desiccation forms a coating over the apertures effectively obstructing water loss. As regulatory devices, this apertural system seems simple enough, but they do illustrate regulatory functions that have adaptive values and are therefore likely to have evolved under the pressure of selection.

A conspicuous feature of apertures is their numerical difference. Why, for example, has the polyaperturate condition apparently evolved from the more common triaperturate dicotyledonous pollen? Could aperture number itself be adaptive? If so, there must be functions other than providing for the exit of a single pollen tube. One function is certainly related to the release of enzymes and other proteins from moistened grains to stigmatic surfaces. Among these proteins emitted from the apertural intine are lytic enzymes, suggesting a function associated with the digestion of substrate on the stigma and thus with the initial nutrition of the tube. Other substances are concerned with compatibility reactions which determine what pollinations will proceed to fertilization and the next generation and which ones will not. They are recognition substances which may or may not be recognized by sites on the protein pellicle of stigmatic papillae (Mattsson et al. 1974). Therefore, aperture adaptation is not only related to germination, but to the control of the breeding system and the physiology of the emerging tube as well. When each aperture is seen as a site for storage and release of physiologically significant materials, and not just an area for potential pollen tube exit, this places the evolution of aperture number in a new perspective.

What of those parts of the exine beyond the apertures? Early observations by Wodehouse (1935) are still appropriate: pollen grains from those plants having reverted to anemophily differ from those of their related entomophilous species by possessing grains with thinner and smoother exines. For example, grains of anemophilous *Populus* are smooth compared to the reticulated exines of *Salix*, a genus largely of entomophilous species. Or, on discussing the wide differences in pollen encountered in the tribe Anthemideae (Asteraceae), Wodehouse noted that the insect pollinated species of *Anthemis (Leucanthemum)* and *Chrysanthemum* have grains with well developed spines and thick exines, whereas those of *Artemisia, Crossostephium* and *Picrothamnus*, which are wind pollinated,

have grains in which the spines are vestigial or absent and the exines are much less thick. He concluded that members of this tribe may be divided rather sharply into two groups consisting of those which are echinate grained and insect pollinated and those with smooth or nearly smooth grained and wind pollinated.

There are also additional characteristics of pollen correlated with mode of pollination. Clearly the lipoidal component of the exine differs, for it is absent or present in only small amounts in anemophilous species, while being a most conspicious adjunct of the pollen of entomophilous plants. This pollenkit provides not only much of the visual and olfactory stimulus needed to guide insects, but it also provides the means for affixing the grains to the pollinator's body (Heslop-Harrison 1971).

But what of the elaborate architectural detail of the sexine which I should mention is largely of sporophytic, not gametophytic, origin? Proteinaceous material can now be recognized in the intra- and interbacular spaces of the wall as well as in the cavea between the sexine and the nexine among asteraceous pollen. This material is entirely of sporophytic origin, having been injected into the cavities of the sexine following derivation from membrane-bounded cisternae released from the tapetum of the anthers during its dissolution (Heslop-Harrison et al. 1973). On moistening, these sexinous-held sporophytic proteins are discharged by the pollen through the micropores in the tectum, micropores which we have observed as a very common feature among the diverse families observed today. This discharge has been particularly well demonstrated by its release within 5 to 30 seconds following pollen moistening of numerous antigens and allergens from the micropores at the base of spines of *Ambrosia* and *Cosmos* (Knox and Heslop-Harrison 1971, Howlett et al. 1973). Therefore, there is a functional significance to the complex internal architecture of the tectal and baculate layers of the exine: it is basically a storage site for materials derived from the tapetum which, through micropores, provides passage for injection of stored materials and for their release when pollen is moistened. In nontectate exines, the spaces between the muri are also concerned with the storage of tapetum derived materials. In the Asteraceae, the exine storage capacity is further enhanced by the development of cavea, which provide enormous reservoirs for products transferred from the sporophyte.

The materials undoubtedly function in several ways. They possess a role in inter- and infraspecific incompatibility systems where the genetic control resides with the parental sporophyte (Heslop-Harrison 1967). This has been shown for *Populus* (Knox et al. 1972) where proteins from the pollen of one species have been used to make pollen of an incompatible foreign species acceptable, and in another example for *Cosmos bipinnatus* (Howlett et al. 1973), extracts of compatible pollen make self-incompatible pollen fully self-pollen acceptable by the stigmas. In addition, exine-held fractions

have recently been shown associated with incompatibility responses in the Brassicaceae (Heslop-Harrison et al. 1974). It seems clear, that for a wide range of flowering plants the exine is the site of recognition materials in incompatibility systems. I should note that the allergenic response in man to these outer wall-based proteins, as well as those held by the intine, is no more than an unfortunate accident of evolution, for their role is to act as recognition substances during pollen-stigma interactions, not to harass those among us who produce immunoglobulin E on contact followed by alarming allergic symptoms.

Briefly, we have glimpsed at several, newly discovered roles involving the pollen wall, largely thanks to the research of Professor J. Heslop-Harrison and his team at the Royal Botanic Gardens, Kew, and to Professor John Rowley and his associates at the Palynological Laboratory, Stockholm. These functional roles of pollen can be related to a number of morphological characters only recently exposed clearly by electron microscopes. For example, the widespread asteraceous cavea could be considered adaptively important, as indeed could the frequency, size and position of the micropores, and the diverse baculate spaces of the sexine. All relate to the storage and conveyance of significant proteinaceous compounds from one generation to the next, yet before the advent of electron microscopy, these features were virtually or entirely unobservable. We need more observations and experiments before the full significance of exine sculpturing is realized. It is now apparent that such diversity is not all incidental, rather, that it is more likely to be accidentally interwoven with adaptive elements which has given us a highly intricate and in many cases selected covering to the male gametophyte of higher plants. More physio-morphological research similar to that described today and taking place at Kew and in Stockholm is imperitive before the relevance of this minute plant, the pollen grain, is fully understood and the selective advantages of its innumerable diversities are fully appreciated.

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A NEW SPECIES OF *HEDEOMA* (LABIATAE) FROM NORTH CENTRAL MEXICO

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Hedeoma is a widespread genus distributed principally in southwestern United States and northern Mexico. Many species of *Hedeoma* are abundant and somewhat weedy herbaceous annuals and perennials and make up what might be termed the central core of the genus. These species are seemingly evolutionarily active and their phenetic coherence is easily perceived. Other subgroupings within *Hedeoma* are quite different. Their species are robust perennials or semi-shrubs, confined largely to isolated mountains in the Chihuahuan and Lower Sonoran deserts. As a group they have been poorly collected and our understanding of their patterns of variation and evolutionary trends is likewise meager. In recent years, with more intensive field work in our desert systems, a number of new taxa and many new collection records have been added to these groups (Irving, 1967; Irving, 1970; Moran, 1969). This work has revealed that intraspecific variation is much wider than was once delineated (Irving, 1968) and that many "clear-cut" taxa must now be viewed more cautiously. Moreover, the genus *Poliomintha*, allied to the shrubby hedeomas of the Chihuahuan Desert, is questionably distinct. Although no changes are proposed here, the recent discoveries of new taxa and the greater understanding of morphological variation, especially in such species as *H. palmeri* and *H. montanum*, have left the generic boundary between *Hedeoma* and *Poliomintha* tenuous.

Field efforts toward the forthcoming flora of the Chihuahuan Desert (Johnston, Hendrickson and collaborators) have uncovered still another new and heretofore uncollected desert species.

HEDEOMA **johnstonii** Irving sp. nov. Fig. 1.

Herbae perennae ad 35 cm altae caulibus multis praeter modos comosos glabris. Folia glabra ovato-oblanceolata 10-20 mm longs 4-7 mm lata dentata base attenuata apice acuta petioli breves. Cymulae 1-3-florae. Calycis tubus 8-12 mm longus tubulosi-infundibuliformis limbus bilabiatus, dentes superi labium reflexum formantes dentes inferi adscendents. Corolla roseoviolacea tenuis ca 45 mm longa. Mericarpia badia ca 2 mm longa 1 mm lata. Chromosomatum numerus ignotus.

Wiry perennial herbs up to 30.0 cm tall; shoots ascending or decumbent, numerous, branching primarily from the base and rooting at the lower nodes, glabrous except for a minute tuft of retrorsely curling hairs at each node. Leaves spreading or ascending, stiff membranous in texture, glabrous, conspicuously glandular punctate on the lower surface, ovate-oblanceolate,

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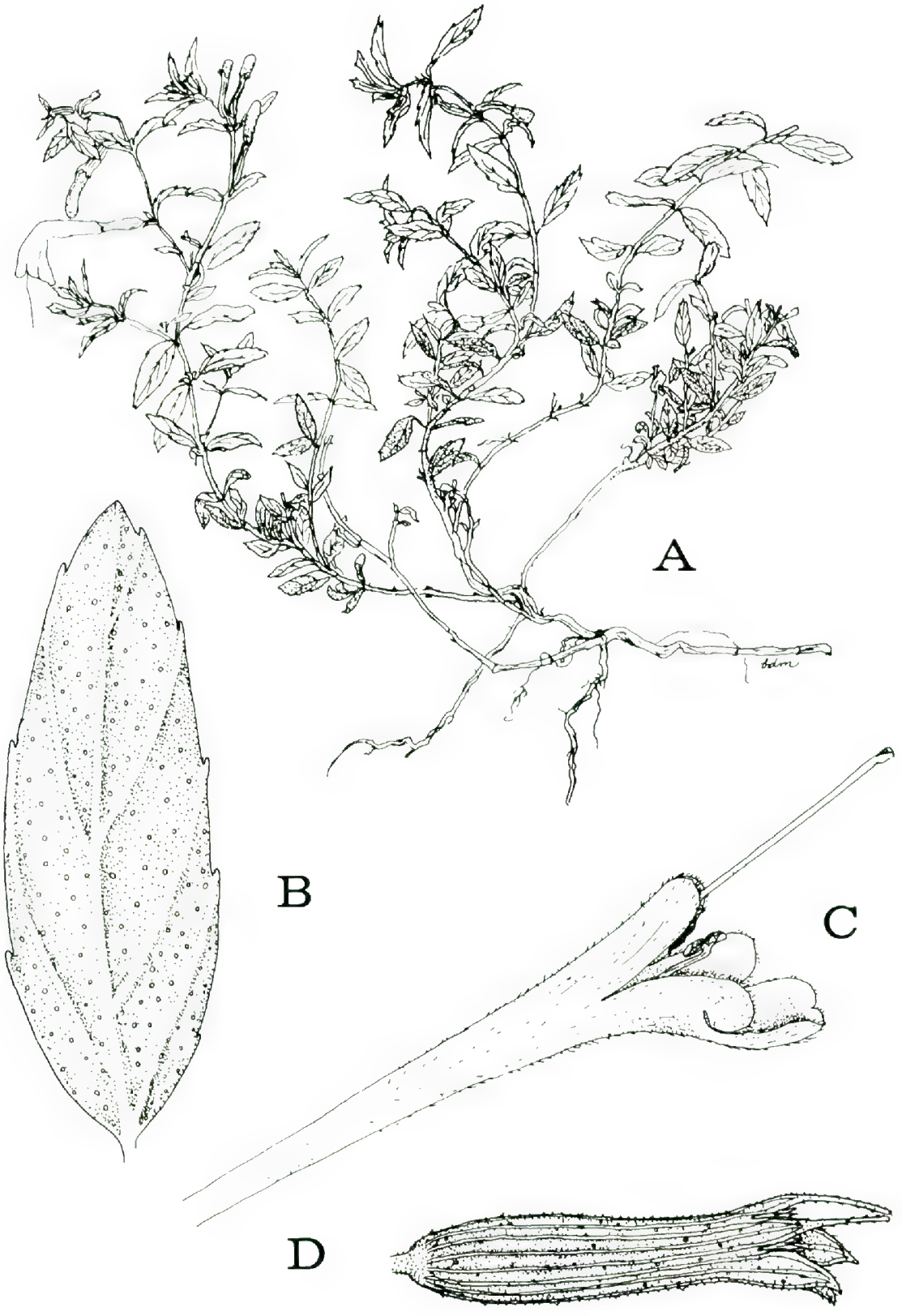

Fig. 1. *Hedeoma johnstonii*. A. Habit, X ½; B. Leaf undersurface, X 5; C. Corolla, X 5; D. Calyx, X 5.

10.0-20.0 mm long, 4.0-7.0 mm wide, dentate with 4-5 pairs of teeth terminating the costae, apex acute, base attenuate to a short petiole (ca. 1.5 mm long), midrib and secondaries conspicuously elevated. Cymules 1-3 flowered, well-spaced along the upper one-third of the stem; primary peduncles ca. 1.0 mm long; primary pedicels ca. 3.0 mm long; bracteoles lanceolate, equal to or slightly longer than the pedicels. Calyx 10.0-15.0 mm long (base to tip of upper teeth), tubular-funnelform, not gibbous and dilated upwardly, sparsely hirsute; upper teeth partially united forming a small but conspicuously reflexed lip, the lobes triangular ca. 1.0 mm long, sparsely ciliate; lower teeth deltoid below ca. 1.0 mm wide, abruptly tapering to an aristate apex, ca. 1.0-2.0 mm long, hirsute-ciliate; annulus located just below the teeth, included. Corolla showy, long and slender, up to 45 mm long from its base to the tip of the upper lip, pink-violet, broadly annulate within where seated in the calyx; upper lip short, ca. 4.0 mm long, 3.0 mm wide, emarginate; the lower lip spreading, ca. 5.0 mm long, ca. 3.0 mm wide. Nutlets 2.0 mm long, 1.0 mm wide. Chromosome number unknown.

Type: MEXICO. Coahuila: Canyon Hundido on north side of Pico de Centinela, Sierra del Jardin, 8 km e. of Rancho El Jardin. "Steep canyon through igneous sierra, gravelly and sandy loam derived from extrusive igneous rocks, 1500-2250 m." 27 July 1973: *M. C. Johnston, F. Chiang, T. L. Wendt* and *D. Riskind 11803*. (Holotype, TEX; Isotypes to be distributed)

Additional Collections. MEXICO. Coahuila. Sierra del Jardin e. of Rancho El Caballo. 16 Sept. 1972. *F. Chiang, T. L. Wendt* and *M. C. Johnston 9341*. Sierra Maderas del Carmen, Canyon El Dos. 3 Aug. 1974. *T. L. Wendt* and *A. Adamcewicz 469*.

Hedeoma johnstonii is a distinctive species apparently endemic to the steep igneous slopes of the Sierra del Jardin, Coahuila, Mexico. As with many of the narrowly endemic species of *Hedeoma* its affinities are puzzling. Its habit is very reminiscent of *Hedeoma bellum*, an endemic of the mountains of the western coast of Mexico, but, in the details of its calyx and corolla, it is more closely allied to *Hedeoma costatum* and its allies. It is readily separated from all species of *Hedeoma* by its glabrous stems, its glabrous, dentate leaves, and its exceptionally long and showy corollas.

The specific epithet honors Marshall C. Johnston who not only first collected the species and judged it to be the "most beautiful of all Hedeomas" but who also has been a continuing source of encouragement and support for many years.

I should like to also thank Dr. Johnston for his Latin diagnosis and express my gratitude to my Research Associate, Susan Brenholts, for her help in many ways. Acknowledgement is also made to Brenda Mahler for her illustrations.

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CASE STUDIES: A NEW APPROACH TO TEACHING PLANT SYSTEMATICS

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The teaching of plant systematics is difficult at best. Because of the broad scope of the subject matter, one of the major problems is deciding exactly what types of information to include and what to ignore. The available options range from a very descriptive approach emphasizing familial, generic, and/or specific recognition to a perspective heavily laced with evolutionary theory and slanted toward experimental systematics or biosystematics. Somewhere between these two extremes lies the majority of existing courses in plant systematics, with the exact emphasis depending upon the interests and background of the professor involved.

Whatever the approach used in teaching plant systematics, in most cases little opportunity is available for the students to learn to make taxonomic decisions. Conspicuously lacking is some format or set of exercises for the student to apply his new understanding of how to assess variation with classical and/or experimental methods. He comes to know well the ways to go about gathering data from plants, but he lacks the experience and confidence to make sound taxonomic judgments.

Such a deficiency in students completing my own course in "Experimental Taxonomy" has been embarassingly apparent (to me as well as to the students) on the final examinations, in which I usually include a hypothetical set of morphological, cytological, and chemical data and ask the students to evaluate these for their taxonomic significance in the particular case study. The students performed poorly, and they raised the question of why this same type of exercise wasn't given to them throughout the course?

As a result of this student criticism, I have developed over the past few years a set of exercises that are designed to help the student gain confidence and proficiency in evaluating comparative data and in making taxonomic decisions. These exercises, or "case studies," are taken from recent systematic literature and are chosen to reflect different taxonomic problems as well as different types of comparative data. It is from the belief that the case study method has proven valuable in my own classes that I offer the following commentary for general appraisal. The purpose of the present paper, therefore, is: (1) to describe in detail exactly what a case study is; (2) to suggest possibilities for effective use of the case studies in the classroom; and (3) to comment on the beneficial results of using case studies, as judged from my own experience.

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DESCRIPTION OF A CASE STUDY

The way in which case studies are structured relates directly to the two main learning objectives for the students: (1) they should be able to recognize discontinuities in sets of comparative data, whether morphological, cytological, chemical, etc: and (2) they should be able to evaluate these observed discontinuities with respect to the various categories or ranks in the taxonomic hierarchy. Other secondary objectives prevail, such as the demonstration of confidence in making decisions and defending viewpoints, but these aspects will be discussed later.

The particular case studies are selected with two criteria in mind: (1) the papers should contain different types of data which should be displayed in different ways, such as in bar graphs, scatter diagrams, and histograms; and (2) the data presented must be displayed in such a way that taxonomic decisions can be made from these figures and tables alone. The first criterion is emphasized to give the student as much practice as possible with handling and interpreting different types of data. The second criterion is necessary so that the students may work on the comparative data themselves without relying on the author's biased discussion. Papers are not desirable, therefore, that treat stimulating problems but have only limited amounts of displayed data. The studies selected need not all be excellent from the standpoint of data-gathering or interpretation either; those with deficiencies also can be used pedagogically to good effect.

The case study is divided into four sections: (1) statement of the problem; (2) materials and methods; (3) data; and (4) abbreviated reference. The first section, the statement of the problem, indicates approximately at what taxonomic level the study focuses. For example, it would be necessary for the student to know that the problem at hand deals with infraspecific rather than intergeneric delimitation. If some guidelines are not given on the approximate rank involved, especially early in the course, the students sometimes approach the problem from very different perspectives. This often results in generating more confusion than understanding. The second section on materials and methods is believed necessary so that the students may see how the comparative data have been gathered (the laboratory of the course may be oriented this way if so desired) and so that they may evaluate critically the appropriateness of the methods for the situation at hand. In most papers the section on methods is set off by itself, which allows for easy removal from the paper proper; in other papers this information must be extracted from the introductory remarks or from the discussion. The third section of the case study contains the data, which are the most important part of the exercise because they serve as the basis for making the taxonomic decisions. As the author usually arranges the data in tables and/or figures to suggest the relationships as he views them, it is useful to scramble the data as presented and give un-

suggestive labels to the initial groups, such as Taxon A, Taxon B, Taxon C, etc. In this way the student does not become prejudiced toward the author's viewpoint. The fourth and final section of the case study includes the abbreviated reference of the paper from which the data were taken. The title is omitted deliberately, because often it can give clues to the rank of the taxa involved or other suggestions that might bias the student.

To give a better idea of what constitutes a case study, an example is included below. It is important to remember that this is only one example from out of hundreds that could have been selected; it is also a relatively simple exercise. Some case studies, especially those involving cytogenetic data, can be very complex, but they are long and space limitations prohibit their inclusion here.

1. *Problem:* Provide a classification for the following taxa (A-D) using any or all of the following categories: genus, species, subspecies, variety, and form.

2. *Materials and Methods:* The taxa under study have been collected rather sparingly. Specimens borrowed from 12 herbaria yielded a total of only 72 collections. This material was supplemented by field observations and mass collections from 13 populations (Fig. 1).

Buds collected in the field for chromosomal studies were fixed in a modified Carnoy's solution (4 parts chloroform: 3 parts absolute alcohol: 1 part glacial acetic acid) and refrigerated immediately. They were transferred after 24 hours to 70% ethyl alcohol "colored" with iron acetate and left under refrigeration until squashes were made some months later. An aceto-orcein stain (0.5% orcein in a solution of 1 part glacial acetic acid: 1 part lactic acid: 1 part water) was employed. Mitotic counts were made from germinating seeds following colchicine treatment.

A single count of $n = 12$ for Taxon B has been reported by Raven & Kyhos (1961, Amer. J. Bot. 48:842). This was corroborated here by both meiotic and mitotic counts for plants in population 698. Meiotic counts of $n = 12$ were obtained for populations 700, 703, and 705, all of these being referable to Taxon A (Fig. 5). Meiosis was regular in all pollen cells examined except for occasional bridges at first anaphase in population 703. Bivalents ordinarily formed two terminalized chiasmata at late diakinesis.

After thorough morphologic investigation of all 13 populations surveyed in this study, certain characteristics of stems and leaves were found to be of greater diagnostic value than others in rendering taxonomic judgments. Figure 15 presents quantitative measurements of these characters. For these data a minimum of 20 individuals from each population was measured. One typical lower leaf per stem was used for blade width, length, and length/width measurements. The total upper surface of these leaves was examined with care in order to determine the minimum and maximum trichome lengths. The single longest leaf per individual stem

was utilized for maximum leaf length, and stem heights were accounted for in attempting to evaluate the variation in the size of the plants. Table 1 supplements the data presented in Fig. 15. In it is summarized the remaining most significant morphologic variation that was found.

3. *Data:* Figs. 1-15; Table 1.

4. *Reference:* Ellison, W. L. 1971. Brittonia 23: 269-279.

EMPLOYMENT OF CASE STUDIES IN THE CLASSROOM

Before the case studies can be used effectively in the classroom, an introduction to concepts of taxonomy and classification (including grouping and ranking) must be presented. If the students have not already learned operational definitions for recognizing taxa and their subsequent ranking, they will not be able to work the case studies. In addition, some introduction to different types of data-gathering and display techniques is recommended. Only in this manner can the student begin to make progress in the critical evaluation of the data included in the case studies. Some considerable attention, therefore, must be given to the introduction of these several aspects of taxonomy before assigning the case studies to the class.

I have found it helpful to begin working first with the students on case study *examples*. These are structured exactly as the exercises described earlier in this paper, but a fifth section is added containing a discussion of the problem and a tentative classification, either drafted by the professor or extracted from the paper itself. In this way the students can check their own classifications against the one provided. When the students have mastered the examples, then they are ready to begin the exercises.

A number of mechanisms might be used for actually presenting the case study exercises to the students, but I have found the following sequence workable. An exercise is assigned to the class on one day with the announced intent of discussing the classifications on another day. At that time, the students are asked to describe their systems, usually accompanied by outlines on the blackboard, for the benefit of and discussion by the rest of the class. If the class is large, time may preclude having every person present his or her classification, but ideally everyone should have the opportunity. After discussion of the individual classifications, with particular emphasis on the prevailing similarities and differences, the professor can present his own and the author's views. Finally, the original paper can be put on library reserve or other accessible location for additional study by the students at their convenience.

BENEFICIAL RESULTS OF USING CASE STUDIES

In my own experience of teaching plant systematics with case studies, I have noticed several beneficial results that accrue to the students. It is realized that the observations to follow have not been quantified or experi-

mentally verified in any way; they are simply syntheses of feedback from students on formal and informal course evaluations both before and after using case studies. It is believed, however, that the benefits mentioned are real.

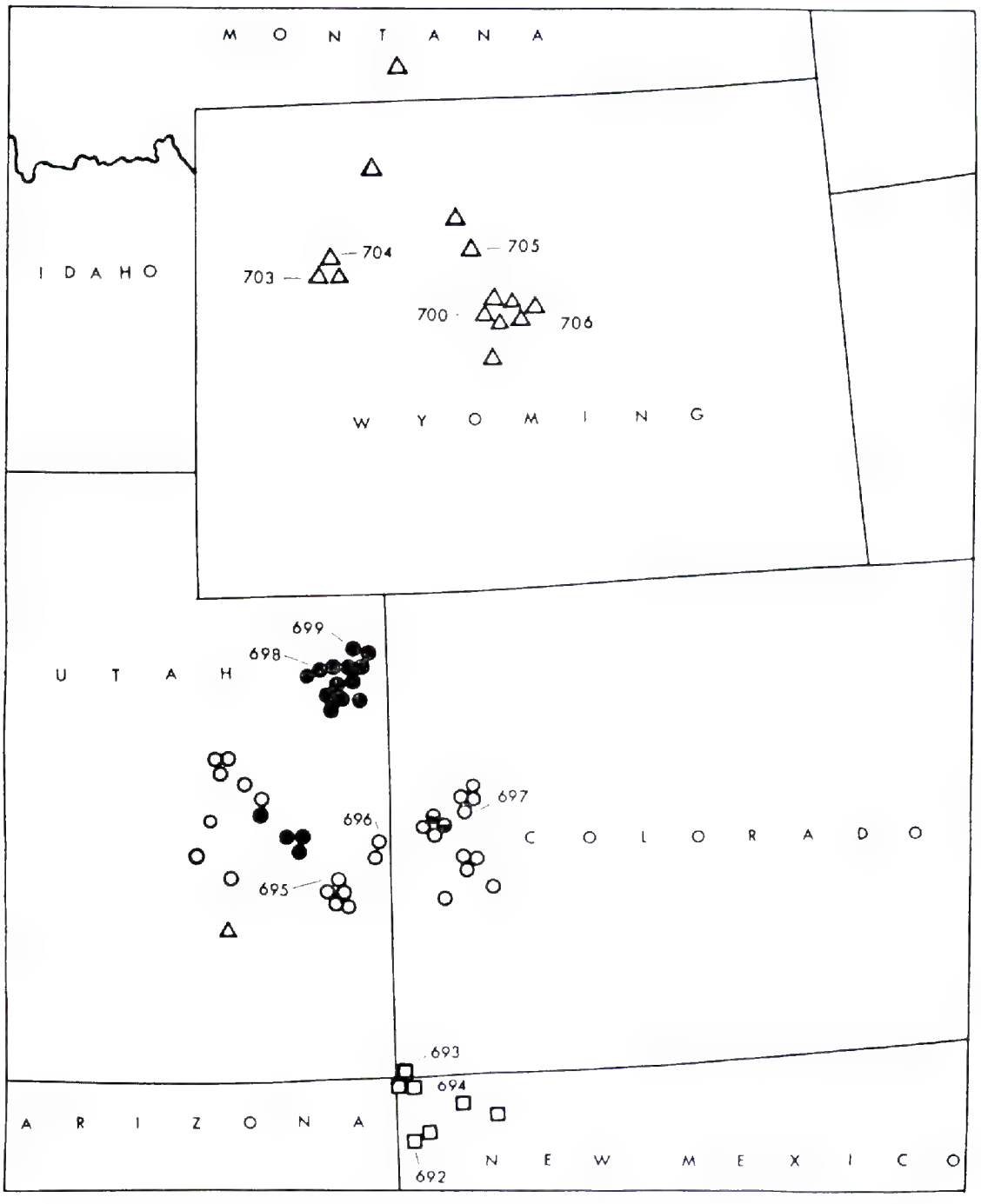
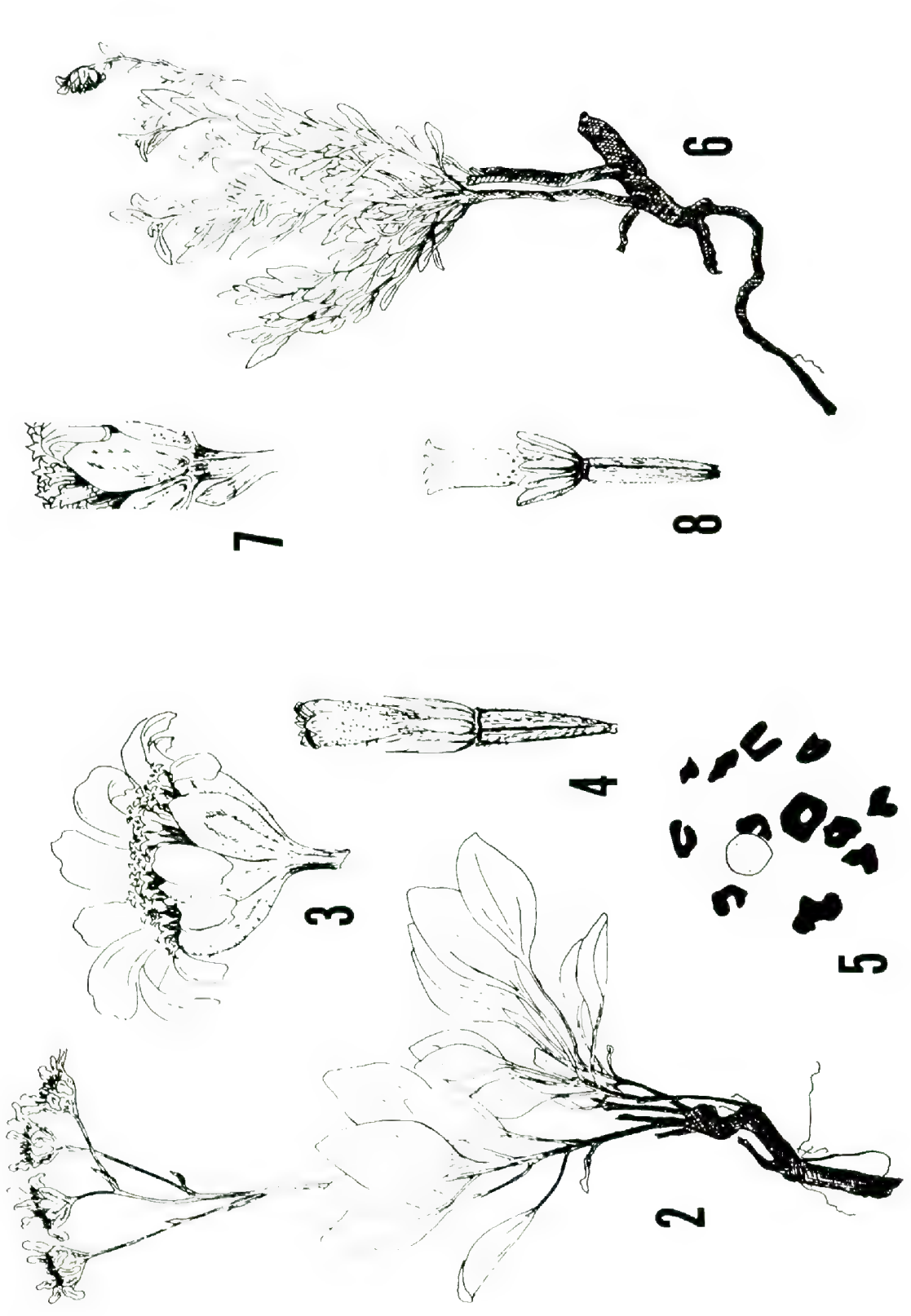
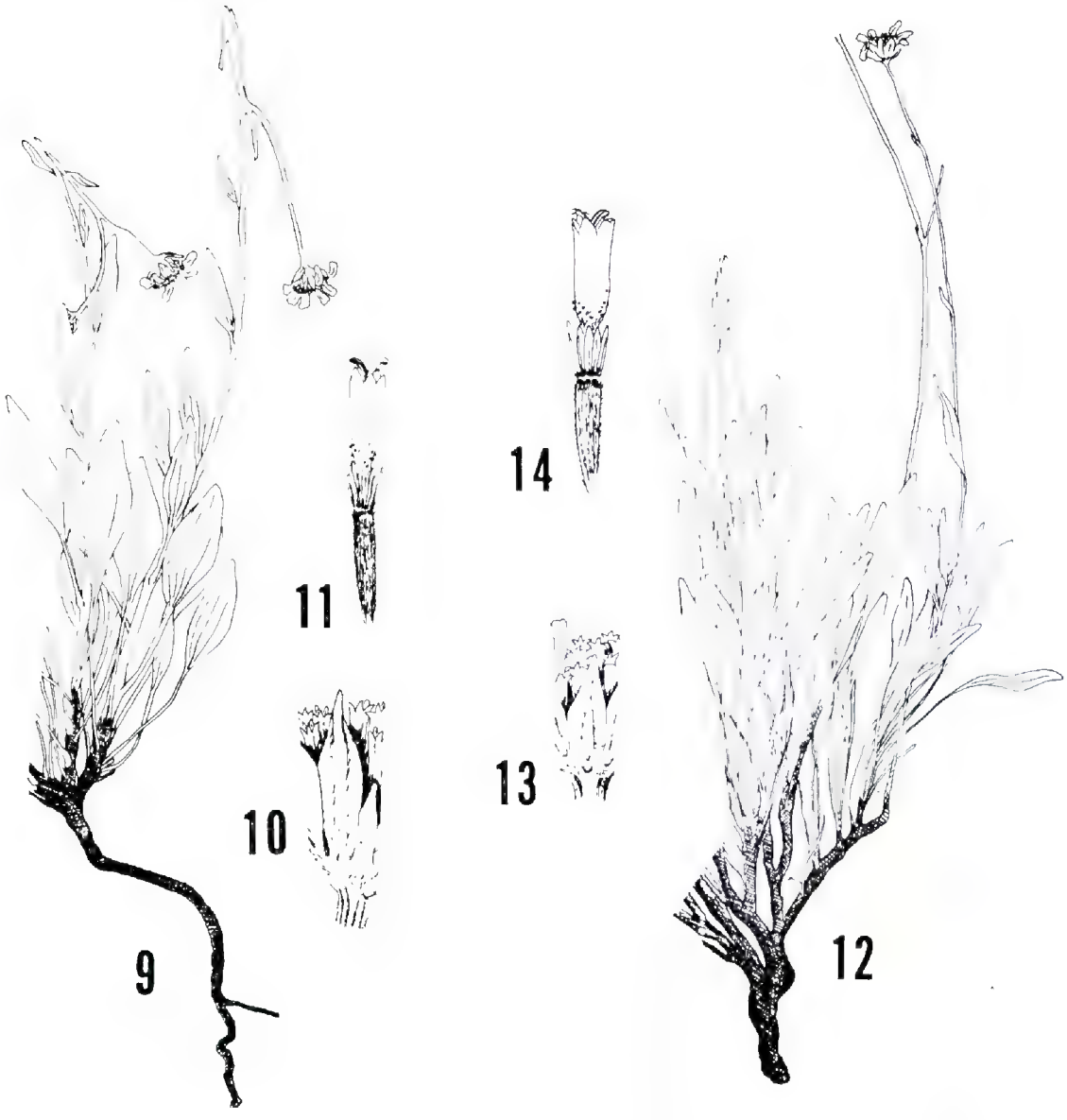


Fig. 1. Map showing distribution of the taxa under study. Taxon A, triangles; Taxon B, dots; Taxon C, circles; intermediates between taxa B and C, half-closed circles; Taxon D, squares. Numbers indicate locations of mass collections.



Figs. 2-8. Taxa A (Figs. 2-5) and D (Figs. 6-8). Habit, Figs. 2 & 6, X 0.5; head, Figs. 3 & 7 (part only), X 3.5; disc floret, Figs. 4 & 8, X 5; chromosomes in diakinesis, Fig. 5, X 1000.

The first beneficial result is that the students seem to finish the course with a higher level of understanding and appreciation for plant systematics than without employment of the case studies. The objectives of being able to recognize discontinuities in sets of comparative data and being able to evaluate these discontinuities with respect to the ranks of the taxonomic hierarchy are achieved in large measure for almost everyone in the class. The students gain first-hand experience in struggling to apply concepts of taxa and categories, and this seems to cement these concepts more firmly. The students also develop a more positive attitude toward plant systematics in general, perhaps due to a better understanding of the difficulties involved with making classifications.



Figs. 9-14. Taxa B (Figs. 9-11) and C (Figs. 12-14). Same scale and views as in Figs. 2-8.

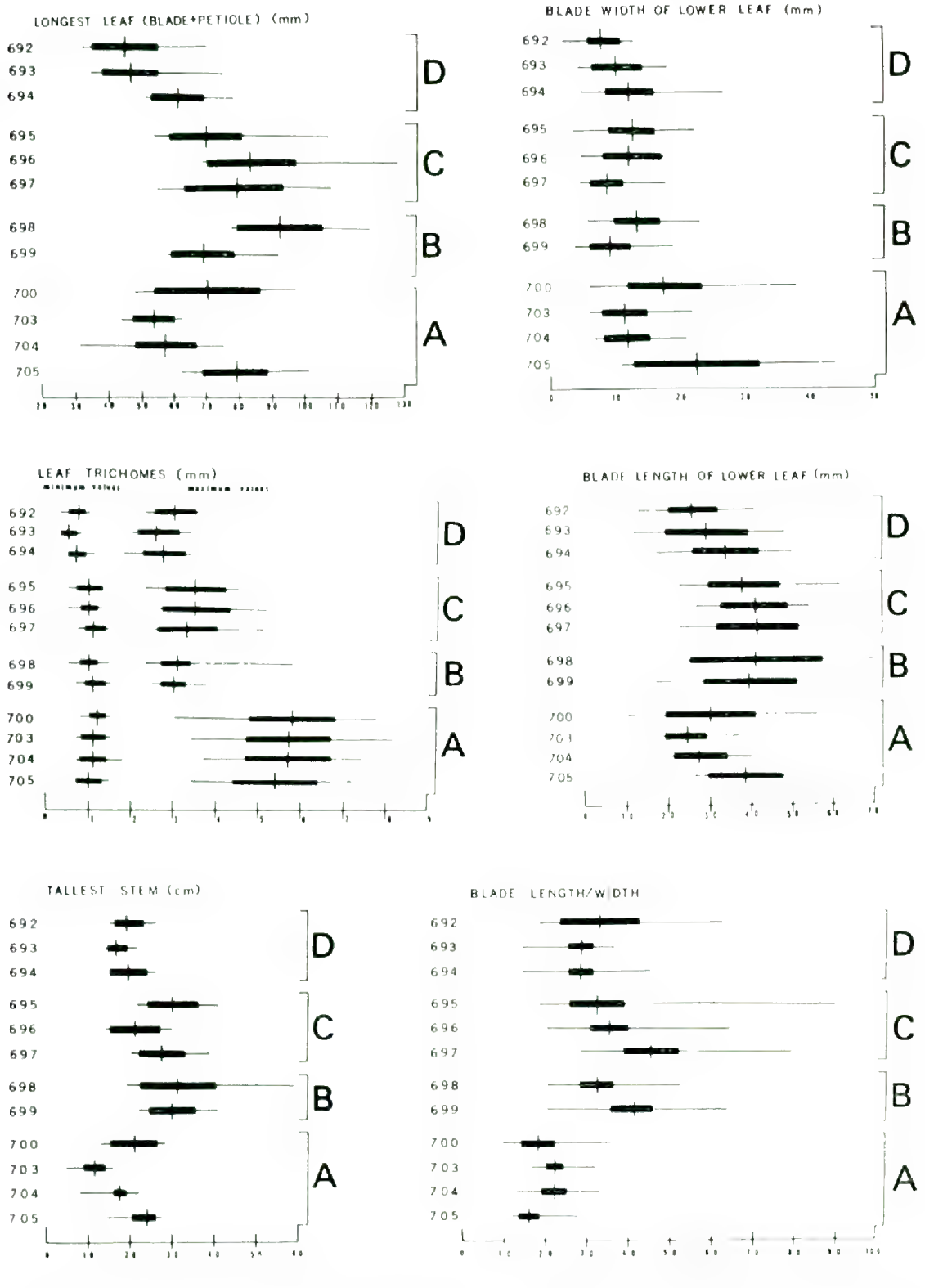


Fig. 15. Quantitative measurements of some characteristics of the four taxa (A-D) in this study. The range of variation observed is indicated by the length of the horizontal line. The resulting unweighted mean and twice the standard error are indicated by the vertical line and accompanying rectangle.

Table 1

Significant Comparative Morphological Characters of the Taxa under Study.

	Taxon A	Taxon B	Taxon C	Taxon D
stem leafiness	mostly basal or occasionally extending midway up stem	both basal & cauline, leaves extending up stem 15–60% of stem height	both basal & cauline, leaves extending 20–60% of stem height	mostly leafy to apex or rarely only midway
lower stem surface processes	glabrous to moderately pubescent w/few-numerous stipitate glands	lightly to heavily pubescent w/few globules of surface exudate	lightly to moderately pubescent w/stipitate glandulosity increasing markedly w/height	glabrous to heavily pubescent w/no-few short stipitate glands
upper stem surface processes	moderately pubescent w/few-numerous stipitate glands	lightly to heavily pubescent w/no-few stipitate glands	glabrous to moderately pubescent w/numerous stipitate glands	lightly to moderately pubescent w/no-few sessile or short stipitate glands
peduncles & bract surface processes	numerous short stipitate glands	no to moderate pubescence w/no-few sessile or short stipitate glands; occasionally glabrate	numerous stipitate glands	lightly to heavily pubescent w/few-numerous stipitate glands
petiole length (mm)	(3)12–45	(7)13–40	16–60	8–35
peduncle length (mm)	(2.5)8–55(65)	11–140	6–140	8–55(75)
bract apex	obtuse, acute	caudate-attenuate or cuspidate (rarely acuminate)	obtuse, acute	obtuse, acute, acuminate
number of disc florets	41–83	40–60	40–75	25–58
disc floret throat length (mm)	2.3–3.8	1.4–3.5	1.5–4.0	2.0–2.8
achene length (mm)	1.0–5.1	2.0–6.2	3.5–6.0(8.0)	3.0–4.6
pappus scale length (mm)	(0.6)1.0–3.2	0.7–3.2	0.7–3.7	1.0–2.4(2.8)

The second beneficial result of using case studies is the positive carry-over to other science courses, and especially to those in other areas of biology. The students gain a better appreciation of the utility of any man-made classification for both animate and inanimate objects. They also are much better prepared to make taxonomic decisions of their own or critically evaluate those of professional taxonomists in other courses that require such efforts (e.g., Introductory Microbiology, Survey of the Animal Kingdom). The students also develop increased proficiency in evaluating methods of data collection, synthesis, and display, which has strong carry-over to all other areas of science.

The third beneficial result of using case studies is the improved intellectual self-confidence that is generated within most students. Occasionally, of course, a student will remain confused and baffled throughout the entire course and will never really understand how to work the case studies; but this occurrence is rare. In general, the students gain much self-confidence in making taxonomic decisions as evidenced by their increasingly perceptive comments throughout the course. Perhaps even more important is that the students gain self-confidence in presenting and defending their own viewpoints before their peers. Sometimes, especially early in the term, the resultant student classifications are widely divergent, and this leads to lively and constructive discussion.

CONCLUSION

From my experience in using case studies in plant systematics courses, I firmly believe that they are an extremely valuable part of the curriculum. The case studies can be used at the undergraduate or graduate levels, with the complexity of the problems adjusted according to the backgrounds and abilities of the students involved. It may have been noticed that the previous section of the paper stressed only beneficial results of using case studies; this was done deliberately, because I believe no detrimental effects accrue, except for the loss of time that alternatively could have been spent on other topics.

Because it involves considerable efforts to extract and rearrange the data from original papers for class use as case studies, it might be worth mentioning that I have assembled a collection of case study examples and exercises for publication in the near future. Along with these case studies have been written several chapters that hopefully will provide at least an introduction to the concepts that are necessary for working effectively the exercises themselves.

ACKNOWLEDGMENTS

Sincerest thanks go to the numerous students who have offered criticisms in the development of the case study concept presented in this paper. Thanks are also due Dr. E. D. Rudolph for reading the final manuscript.

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ANNOTATED LIST OF VASCULAR PLANTS IN MOBILE, ALABAMA

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The need for a reasonably complete and recent list of plants in the Mobile area has been felt in the teaching of some of our biology courses and in other activities. Therefore a floristic survey of the University of South Alabama property and of the adjacent Municipal Park area located in the northwestern part of Mobile, was conducted from 1968 to the end of 1970.

The study area covers approximately three sections of land, and consists primarily of rolling, sandy, Longleaf pinewoods typical of the region. It is traversed by Three Mile Creek and adjacent swamp forests and wet savannahs. The elevation of this area ranges from about 80 feet to 220 feet. The upland pinewoods is dominated by longleaf pine, and a diversity of oaks such as laurel oak *(Quercus hemispherica)*, southern red oak (*Q. falcata*), turkey oak (*Q. laevis*), and sand post oak (*Q. margaretta*). The understory includes ericaceous shrubs such as the blueberries (*Vaccinium arboreum, V. elliottii,* and *V. darrowii*), yaupon (*Ilex vomitoria*), winged sumac (*Rhus copallina*), flowering dogwood (*Cornus florida*), and numerous vines such as the green brier (*Smilax auriculata*) and yellow jessamine (*Gelsemium sempervirens*). The ground layer in this pinewoods consists of a great variety of herbs belonging primarily to the grass, the legume, and the aster families. Representatives of these families are *Andropogon tener, A. scoparius* (little bluestem), the dropseed grass (*Sporobolus junceus*), the love grasses (*Eragrostis spectabilis* and *E. refracta*), sand lupine (*Lupinus diffusus*), the rattleboxes (*Crotalaria angulata* and *C. purshii*), the beggars ticks (*Desmodium laevigatum* and *D. viridiflorum*), *Rhynchosia galactioides*, the sunflower (*Helianthus radula*), deer tongue (*Trilissa odoratissima*), the goldenrod (*Solidago odora*), the ironweed (*Vernonia angustifolia*) and *Coreopsis major*. Herbs belonging to other families occurring commonly in the lonfleaf pinewoods include scarlet basil (*Calamintha coccinea*), the sage (*Salvia azurea*), Queen's delight (*Stillingia sylvatica*), *Hibiscus aculeatus, Verbena carnea*, flowering spurge (*Euphorbia corollata*) and spurge nettle (*Cnidoscolus stimulosus*). The swamp forest bordering Three Mile Creek is dominated by sweet bay (*Magnolia virginiana*), tupelo gum (*Nyssa sylvatica var. biflora*), red maple (*Acer rubrum*) and tulip tree (*Liriodendron tulipifera*). The understory consists of a few shrubs such as Virginia willow (*Itea virginica*), star-anise (*Illicium floridanum*), *Leucothoe axillaris*, and strawberry bush (*Euonymus americanus*). The

SIDA 7(2): 118—146. 1977.

ground layer in the Bay Forest is scant consisting largely of shade-tolerant plants such as netted chain-fern (*Woodwardia areolata*), *Gratiola virginiana*, and *Lindernia dubia*.

The transition zone between the Longleaf pine forest and the Bay Forest is occupied by a rather narrow strip of wet savannah including a great diversity of plants. Common shrubs in this area are gallberry (*Ilex glabra*), wax myrtle (*Myrica cerifera*), black titi (*Cliftonia monophylla*) and sweet pepperbush (*Clethra alnifolia*). The herb layer is very dense and varied including numerous sedges such as beak rushes (*Rhynchospora* spp.), sundews (*Drosera* spp.), meadow beauties (*Rhexia alifanus, R. lutea, R. mariana*), milkworts (*Polygala lutea, P. ramosa*), violets (*Viola primulifolia, V. lanceolata*), the orchids (*Calopogon pulchellus* and *Spiranthes praecox*), and numerous panic grasses such as *Panicum ciliatum, P. ensifolium, P. scabriusculum* and *P. strigosum*.

Other plant associations represented to a lesser extent in the study area include the pond margins and the floating and submerged plants at Mobile Municipal Park, as well as the fast-growing weedy habitats of roadsides, clearings, lawns and pathways.

The climate of Mobile is subtropical and greatly influenced by the Gulf of Mexico. Based on a forty year record (U.S. Dept. Agric. 1941), the average July temperature is about 82°F: and the average January temperature is about 53°F. The average growing season lasts 298 days without killing frost from February 17 to December 12. The average annual precipitation is about 60 in. with 33 in. falling during the warm season.

Before the turn of our century, few botanists had investigated the flora of southern Alabama. In 1857, Charles Mohr established himself in the drug business in Mobile where he remained until 1900, shortly before his death. During this time, he collected plants extensively throughout the State and particularly in the Mobile Bay region. His efforts culminated in the publication of his book on the plant life of Alabama in 1901. Earlier, Hezekiah Gates, a pharmacist in Mobile, collected plants of the coast region from 1836 to 1842.

During our century, much interest has been shown in the flora of the islands separating the Mississippi Sound and the Gulf of Mexico. F. E. Lloyd and S. M. Tracy (1901) surveyed the insular flora of adjacent Mississippi and Louisiana. W. T. Pennfound and M. E. O'Neill (1934) studied the vegetation of Cat Island. L. J. Pessin and T. D. Burleigh (1941) recorded observations on the forest biology of Horn Island, and later E. Avery Richmond (1962, 1968) compiled a list of the plants on this island. G. J. Miller and S. B. Jones Jr. (1967) reported on the vascular flora of Ship Island, Mississippi. Rebecca Deramus (1970) conducted a floristic survey of vascular plants on Dauphin Island, in the extreme south of Mobile County.

We should also briefly note some of the numerous contributions of Roland

M. Harper to a better general knowledge of the plants of our region, especially his catalogue of the trees, shrubs and vines of Alabama (1928). Recently Ross C. Clark (1971) greatly expanded our understanding of the distribution of woody plants in the State.

During our floristic survey, approximately 3500 specimens were collected and identified. One set of specimens is kept in the Natural History Collection of the University of South Alabama. Another set is being sent to the University of North Carolina Herbarium. This sampling represents 876 species and varieties, 414 genera included in 125 families of vascular plants.

The grass family (Poaceae) is best represented in the study area with 135 species and varieties, followed by the composite family (Asteraceae) with 110 species and varieties, the sedge family (Cyperaceae) with 69 species, and the family Fabaceae with 65 species.

In the following checklist, the nomenclature and taxonomy follow primarily that of Radford, Ahles and Bell (1968). Small (1933) and other major plant manuals were also consulted as well as recent treatments of plant groups well represented in our area such as those by Kral dealing with *Xyris* (1966) and with *Bulbostylis* and *Fimbristylis* (1971).

The synonymy is that of Mohr (1901), the latest comprehensive book treating the flora of our region. To render the list more useful, a brief statement of habitat and of the frequency of occurence is included.

One hundred and twenty-five species and varieties included in the following list were not reported in Mohr's catalogue. The names of these plants are preceded by a single asterisk. Twenty-eight additional species and varieties on this list were reported by Mohr to occur in the State outside of Mobile County. The names of these plants are preceded by a double asterisk. Plants which were not reported by Mohr fall largely into two major categories: 1) species described after 1901 and closely related to plants reported by Mohr; their recognition may merely reflect a "narrower" species interpretation than that of Mohr; 2) introductions or "aggressive" weeds which have recently spread to our region such as *Stachys floridana* and *Phyllanthus urinaria.* Naturalized plant species are indicated by "N" at the end of the entry pertaining to them in the following list.

I would like to express my appreciation to Dr. Sidney McDaniel for annotating a number of "troublesome" specimens, especially those belonging to the genus *Vaccinium.* I am grateful to Dr. Albert E. Radford for reading the preliminary list and suggesting improvement in its presentation. I am also grateful to Dr. Robert Kral for making numerous helpful suggestions for improvement of the original manuscript. I am thankful to Dr. Grady Webster for verifying the identity of *Phyllanthus urinaria* and to Dr. Murray Evans for verifying the determination of *Thelypteris torresiana* and *T. dentata.*

I am indebted to Dr. Joab Thomas of the University of Alabama, to Dr. Joseph Ewan of Tulane University, and to Dr. J. Ray Watson of Mississippi

State University for allowing me to consult the herbaria of which they have charge. Dr. Ray Watson and Dr. Ken Rogers also kindly allowed me to benefit generally from their knowledge of our Southeastern flora.

Finally I am thankful to the research committee of the University of South Alabama for supporting this project.

ANNOTATED LIST

LYCOPODIACEAE

LYCOPODIUM ALOPECUROIDES L. Foxtail Clubmoss. Common in wet sandy pinelands.

LYCOPODIUM ADPRESSUM (Chapm.) Lloyd & Unders. Southern Bog Clubmoss. Infrequent in wet sandy pinelands.

LYCOPODIUM CAROLINIANUM L. Slender Clubmoss. Rare in wet sandy pinelands.

LYCOPODIUM CERNUUM L. Nodding Clubmoss. Rare in moist, open sandy area near swamp.

OPHIOGLOSSACEAE

OPHILOGLOSSUM CROTALOPHOROIDES Walt. Tuberous Adders-tongue. Infrequent and inconspicuous in lawns and meadows.

OSMUNDACEAE

OSMUNDA CINNAMOMEA L. Cinnamon Fern. Common in moist pinelands and along margins of swamp forest.

OSMUNDA REGALIS L. Royal Fern. Infrequent in moist open areas.

SCHIZAEACEAE

*LYGODIUM JAPONICUM (Thunb.) Sw. Japanese Climbing Fern. Infrequent in moist woods, ditches. N.

PTERIDACEAE

PTERIDIUM AQUILINUM (L.) Kuhn. Bracken Fern. Common in dry, sandy open woods.

ASPIDIACEAE

*ATHYRIUM ASPLENIOIDES (Michx.) A.A. Eat. Southern Lady Fern. Infrequent in swamp forests.

ONOCLEA SENSIBILIS L. Sensitive Fern. Infrequent along margins of swamp.

*THELYPTERIS DENTATA (Forsk.) C.Chr. Rare in moist pinelands.

THELYPTERIS NORMALIS (Christens) Moxley. [Dryopteris patens (SW.) Kuntze] Common along margin of swamp forest.

THELYPTERIS PALUSTRIS Schott. Marsh Fern. [Dryopteris thelypteris (L.) Gray] Infrequent in wet savannahs.

*THELYPTERIS TORRESIANA Alston. Infrequent in swamp forest.

BLECHNACEAE

WOODWARDIA AREOLATA (L.) Moore. Netted Chain-fern. Common in swamp forest.

WOODWARDIA VIRGINICA (L.) J. E. Smith. Common in wet savannahs.

ASPLENIACEAE

ASPLENIUM PLATYNEURON (L.) Oakes. Ebony Spleenwort. Infrequent in mesic, sandy woods.

POLYPODIACEAE

POLYPODIUM POLYPODIOIDES (L.) WATT. Resurrection Fern. Infrequent on large trees.

PINACEAE

PINUS ELLIOTTII Engelm. Slash Pine. Infrequent in wet pinelands.
PINUS PALUSTRIS Mill. Longleaf Pine. Common in sandy upland woods and along margin of swamp forest.
PINUS TAEDA L. Loblolly Pine. Infrequent in open, sandy areas.

CUPRESSACEAE

CHAMAECYPARIS THYOIDES (L.) BSP. White Cedar. Infrequent in swamp forest.
JUNIPERUS VIRGININIANA L. Red Cedar. Infrequent in dry, sandy soil.

TYPHACEAE

TYPHA LATIFOLIA L. Common Cat-tail. Infrequent in wet areas and ditches.

SPARGANIACEAE

SPARGANIUM AMERICANUM Nutt. [S. androcladum (Engelm.) Morong] Bur-reed. Infrequent in opening within swamp forest and along stream.

POTAMOGETONACEAE

POTAMOGETON DIVERSIFOLIUS Raf. Pondweed. Infrequent, floating in stream.

ALISMATACEAE

**SAGITTARIA ENGELMANNIANA J.G. Sm. Arrowhead. Rare on edges of pond.
SAGITTARIA FALCATA Pursh. [S. lancifolia falcata (Pursh) J.G. Smith]. Infrequent on margins of pond.
SAGITTARIA LATIFOLIA Willd. Wapato. Common in wet savannahs and along pond margins.

HYDROCHARITACEAE

*EGERIA DENSA Planch. Elodea. Infrequent on sandy stream bank.

POACEAE

AGROSTIS ELLIOTTIANA Schultes. Silvery hair grass. Infrequent in meadows.
AGROSTIS HYEMALIS (Walt.) BSP. Bent Grass. Common on roadsides, cultivated and waste areas.
AGROSTIS PERENNANS (Walt.) Tuckerm. [A. intermedia Scribner] Autumn Bent Grass. Common in moist sand along stream.
*AIRA ELEGANS Willd. ex Gaudin. Hairgrass. Rare along roadside.
ALOPECURUS CAROLINIANUS Walt. [A. geniculatus L.] Foxtail Grass. Rare in moist lawns and fields.
ANDROPOGON GERARDI Vitman. Big Bluestem. Infrequent in dry, open woods.
ANDROPOGON GLOMERATUS (Walt.) BSP. Bushy beardgrass. Infrequent in moist open areas.
ANDROPOGON SCOPARIUS Michx. Little Bluestem. Common in dry, open woods.
*ANDROPOGON SUBTENUIS Nash. Beardgrass. Common on dry, sandy soil.
ANDROPOGON TENER (Nees) Kunth. Common in dry, open woods.
ANDROPOGON TERNARIUS Michx. [A. argyraeus Schult.] Infrequent in dry, sandy soil.
ANDROPOGON VIRGINICUS L. [A. capillipes Nash] Broom Sedge. Infrequent in dry, open woods.
ANTHAENANTIA VILLOSA (Michx.) Beauv. Common in dry woods.
*ARISTIDA INTERMEDIA Scribn. and Ball. Three Awn Grass. Infrequent in dry, sandy woods.
ARISTIDA LANOSA Muhl. ex Ell. [A. lanata Poir.] Common in dry, sandy woods.
ARISTIDA LONGESPICA Poir. [A. gracilis Ell.] Infrequent in dry, open sites.
ARISTIDA MOHRII Nash. Infrequent in dry, sandy woods.
ARISTIDA PURPURASCENS Poir. Common in dry, open sites.
*ARISTIDA VIRGATA Trin. [close to A. palustris (Chap.) Vasey in Mohr] Infrequent in moist open areas.
ARUNDINARIA TECTA (Walt.) Muhl. Cane. Infrequent colonies in low woods.
*ARUNDO DONAX L. Giant Reed. Rare on roadside, escaped. N.

*AVENA SATIVA L. Oats. Rare in waste places. N.

AXONOPUS AFFINIS Chase. [Paspalum compressum (Sw.) Nees] Carpet Grass. Infrequent in low, open areas, cultivated.

*BRACHIARIA PLATYPHYLLA (Griseb.) Nash. Infrequent in open, disturbed areas.

BRIZA MINOR L. Quaking Grass. Rare in moist, open disturbed areas. N.

BROMUS CATHARTICUS Vahl. [B. unioloides (Willd.) H.B.K.] Brome Grass. Infrequent in disturbed sites. N.

*BROMUS COMMUTATUS Schrad. [B. racemosus L.] Rare in dry waste places. N.

*BROMUS TECTORUM L. Rare on dry roadside.

CENCHRUS ECHINATUS L. Sandspur. Common on dry roadsides and waste places.

*CENCHRUS GRACILLIMUS Nash. Infrequent on dry roadsides.

CENCHRUS PAUCIFLORUS Benth. [C. incertus M.A. Curtis] Common on dry sandy soil.

CHASMANTHIUM LAXA (L.) Yates. [Uniola laxa (L.) B.S.P.] Infrequent in mesic woods.

CHASMANTHIUM SESSILIFLORA (Poir) Yates. [Uniola longifolia Scribner] Infrequent in woodland borders.

CHLORIS PETRAEA Sw. [C. swartziana Doell] Finger Grass. Rare on dry, sandy disturbed sites.

CYNODON DACTYLON (L.) Pers. [Capriola dactylon (L.) Kuntze] Bermuda Grass. Common on roadsides, waste places, lawns. N.

DACTYLIS GLOMERATA L. Orchard Grass. Rare in cultivated grounds. N.

DACTYLOCTENIUM AEGYPTIUM (L.) Beauv. Crowfoot Grass. Common on roadsides, disturbed places. N.

DANTHONIA SERICEA Nutt. Oat Grass. Common in dry, open woods.

**DIGITARIA ISCHAEMUM (Schreber) Schreber ex Muhl. [Syntherisma lineare (Krock.) Nash] Smooth Crab Grass. Infrequent in disturbed areas.

**DIGITARIA FILIFORMIS (L.) Koel. var. VILLOSA (Walt.) Fern. [Syntherisma villosum Walt.] Crab Grass. Common in dry, sandy areas.

DIGITARIA SANGUINALIS (L.) Scop. [Syntherisma sanguinale (L.) Nash] Common Crab Grass. Common on roadsides, waste places, cultivated ground.

DIGITARIA SEROTINA (Walt.) Michx. [Syntherisma serotinum Walt.] Rare lawn weed.

ECHINOCHLOA COLONUM (L.) Link. [Panicum colonum L.] Jungle Grass. Rare on roadside. N.

ELEUSINE INDICA (L.) Gaertn. Goose Grass. Common on roadsides, waste places. N.

*ERAGROSTIS CURVULA (Schrad.) Nees. Love Grass. Infrequent in dry, sandy open areas.

ERAGROSTIS ELLIOTTII S. Wats. [E. nitida (Ell.) Chap.] Infrequent on dry roadsides and waste places.

ERAGROSTIS HIRSUTA (Michx.) Nees. Common in dry open woods, roadsides.

ERAGROSTIS OXYLEPIS (Torr.) Torr. [E. secundiflora Presl.] Rare on dry roadsides.

ERAGROSTIS REFRACTA (Muhl.) Scribn. Common in moist pinelands.

ERAGROSTIS SPECTABILIS (Pursh) Steud. [probably corresponds to E. pectinacea (Michx.) Steud. in Mohr] Common in dry open woods, roadsides.

*EREMOCHLOA OPHIUROIDES (Munro) Hack. Centipede Grass. Infrequent in dry, open waste places. N.

ERIANTHUS ALOPECUROIDES (L.) Ell. Plume Grass. Common in woodland borders, moist savannahs.

ERIANTHUS GIGANTEUS (Walt.) Muhl. [E. saccharoides Michx.] Infrequent in moist savannahs.

*FESTUCA ARUNDINACEA Schreb. Reed Fescue. Rare on roadsides. N.

*FESTUCA MYUROS L. Fescue. Infrequent on cultivated and waste grounds.

FESTUCA OCTOFLORA Walt. Infrequent on cultivated and waste grounds.

GYMNOPOGON AMBIGUUS (Michx.) BSP. Windmill Grass. Common in dry woods.

GYMNOPOGON BREVIFOLIUS Trin. Common in dry woods.

HACKELOCHLOA GRANULARIS (L.) Kuntze. Rare in open, disturbed area. N.

HORDEUM PUSILLUM Nutt. Little Barley. Infrequent on waste grounds.

HYDROCHLOA CAROLINIENSIS Beauv. [H. fluitans (Michx.) Nash] Infrequent aquatic.

*IMPERATA BRASILIENSIS Trin. Infrequent on open marshy areas. N.

LEERSIA HEXANDRA Swartz. [Homalocenchrus hexandrus (Sw.) Kuntze] Cut Grass. Infrequent in moist, shaded areas.

LEERSIA ORYZOIDES (L.) Swartz. [Homalocenchrus oryzoides (L.) Pollich] Common on margins of pond.

LEERSIA VIRGINICA Willd. [Homalocenchrus virginicus (Willd.) Britton] Infrequent in moist shaded areas.

*LEPTOCHLOA UNINERVIA (Presl.) Hitchc. Sprangletop. Rare along dry, sandy roadside.

**LEPTOLOMA COGNATUM (Schult.) Chase. [Panicum cognatum Schult.] Witch-Grass. Rare on dry, open sandy site.

*LOLIUM MULTIFLORUM Lam. Rye Grass. Common on waste places, lawns. N.

LUZIOLA BAHIENSIS (Steud.) Hitchc. [L. alabamensis Chapm.] Rare on margins of swamp and along stream. N.

MUHLENBERGIA EXPANSA (DC.) Trin. [M. trichopodes (Ell.) Chap.] Muhl. Common in dry, open pinelands.

**MUHLENBERGIA SCHREBERI J.F. Gmel. [M. diffusa Schreb.] Nimblewill. Rare in shady waste places.

OPLISMENUS SETARIUS (Lam.) Roem. & Schult. Rare in mesic woods.

PANICUM ACICULARE Desv. ex Poir. [P. arenicola Ashe] Panic Grass. Common on open, sandy woods, roadsides.

PANICUM AGROSTOIDES Spreng. [Includes P. elongatum ramosior Mohr] Common in low woods, along margins of ponds and streams.

PANICUM ANCEPS Michx. var. ANCEPS. [Includes P. rostratum Muhl.] Common on roadsides.

*PANICUM ANCEPS var. RHIZOMATUM (Hitchc. & Chase) Fern. Infrequent on roadsides,, moist pinelands.

PANICUM ANGUSTIFOLIUM Ell. Common in dry, open woods.

PANICUM BARBULATUM Michx. Infrequent on sandy stream banks.

PANICUM CILIATUM Ell. Infrequent in moist pinelands.

*PANICUM COMMONSIANUM Ashe. Infrequent in dry, open woods.

PANICUM CURTIFOLIUM Nash. Infrequent in open, boggy areas.

PANICUM COMMUTATUM Schult. Infrequent in mesic woods.

PANICUM DICHOTOMIFLORUM Michx. [P. proliferum Lam.] Common in low woods, waste places.

PANICUM DICHOTOMUM L. [Includes P. ludicum Ashe] Infrequent in low pinelands, stream banks.

*PANICUM ENSIFOLIUM Baldw. ex Ell. Infrequent in moist, open areas.

PANICUM HIANS Ell. [P. melicarium Michx.] Infrequent along margins of stream and ponds, ditches.

PANICUM LANCEARIUM Trin. [P. nashianum Scribner] Rare in low sandy woods.

PANICUM LANUGINOSUM Ell. (sensu lato) Common in dry, open woods, roadsides.

PANICUM LAXIFLORUM Lam. [Includes P. pyriforme Nash] Infrequent in mesic woods.

*PANICUM LINDHEIMERI Nash. [Possibly corresponds to P. paucipilum Nash.] Infrequent in open woods, roadsides.

PANICUM LONGIFOLIUM Torrey. Infrequent on moist open streambank.

PANICUM OLIGOSANTHES Schult. Infrequent in dry, open woods.

*PANICUM PATENTIFOLIUM Nash. Rare in dry, open areas.

*PANICUM RAMOSUM L. Rare on roadside. N.

*PANICUM RAVENELII Scribn. & Merr. Common in dry pinelands.

PANICUM REPENS L. Torpedo Grass. Common along margins of ponds.

PANICUM SCABRIUSCULUM Ell. Common in wet savannahs, ditches, margins of ponds.

PANICUM SCOPARIUM Lam. [Includes also P. pubescens Lam. and P. viscidum Ell.] Infrequent in moist open areas.

PANICUM SPHAEROCARPON Ell. Common in dry, open woods, roadsides.

PANICUM STRIGOSUM Muhl. [P. longipedunculatum Scribner] Rare in moist open areas.

PANICUM TENUE Muhl. [Includes P. trifolium Nash and P. albomarginatum Nash] Common in dry disturbed roadsides and woods.
PANICUM VERRUCOSUM Muhl. Common in borders of swamps and wet ditches.
PANICUM VILLOSISSIMUM Nash. [Includes also P. haemacarpon Ashe, P. xanthospermum Scribner and Mohr, and P. pseudopubescens Nash] Common in dry, open woods, pinelands.
PANICUM VIRGATUM L. Switchgrass. Infrequent in low open woods.
PASPALUM BIFIDUM (Bertol.) Nash. Infrequent in sandy pine and oak woods.
PASPALUM CONJUGATUM Bergius. Rare lawn weed.
PASPALUM DEBILE Michx. [Included by Mohr under P. longipedunculatum Le Conte] Infrequent in open, disturbed area.
PASPALUM DIFFORME Le Conte. Rare in moist, sandy soil.
PASPALUM DILATATUM Poir. Dallis Grass. Common on roadsides, waste places. N.
PASPALUM FLORIDANUM Michx. Common on roadsides, waste places.
PASPALUM LAEVE Michx. Infrequent in open woods, waste grounds.
*PASPALUM NOTATUM Flugge. Bahia Grass. Common on roadsides, waste places.
PASPALUM PLICATULUM Michx. Infrequent in dry, open woods.
PASPALUM PRAECOX Walt. Infrequent in low pine woods.
PASPALUM SETACEUM Michx. [P. ciliatifolium Michx.] Common in dry, open woods, roadsides, waste ground.
PASPALUM SUPINUM Bosc. [P. ciliatifolium dasyphyllum (Ell.) Chap.] Infrequent in dry, open ground.
*PASPALUM URVILLEI Steud. Vasey Grass. Common on roadsides, waste ground. N.
PHALARIS CAROLINIANA Walt. Canary Grass. Infrequent in waste places.
POA ANNUA L. Blue Grass. Common on lawns waste places. N.
POLYPOGON MONSPELIENSIS (L.) Desf. Rabbit-foot Grass. Rare in marshy area along stream. N.
SACCIOLEPIS STRIATA (L.) Nash. [Panicum gibbum Ell.] Common along border of stream and ponds.
SECALE CEREALE L. Rye. Rare along roadside. N.
SETARIA GENICULATA (Lam.) Beauv. [Chaetochloa imberbis (Poir.) Scribn. and Chaetochloa gracilis (H.B.K.) Scribn. and Merr.] Bristlegrass. Rare in waste places.
SORGHASTRUM ELLIOTTII (Mohr) Nash. [Chrysopogon elliottii Mohr.] Indian Grass. Common in dry, open woods.
SORGHASTRUM NUTANS (L.) Nash. [Chrysopogon nutans linneanus Doell] Infrequent in dry, open woods.
SORGHUM HALEPENSE (L.) Pers. Johnson Grass. Common on roadsides, waste places. N.
SPHENOPHOLIS FILIFORMIS (Chapm.) Scribn. [Eatonia filiformis (Chap.) Vasey] Wedge Grass. Common in dry, open woods.
SPHENOPHOLIS OBTUSATA (Michx.) Scribn. [Eatonia obtusata (Michx.) Gray var. Repens (Walt.) A.H. Moore] Common on moist roadsides, waste places.
*SPOROBOLUS CLANDESTINUS (Biele) Hitchc. Dropseed. Rare in dry, open woods.
SPOROBOLUS JUNCEUS (Michx.) Kunth. Common in dry, open woods.
SPOROBOLUS POIRETTI (Roem. & Schult.) Hitchc. [probably included in S. indicus (L.) R. Br.] Smut Grass. Common on roadsides, cultivated and waste grounds. N.
*TRIDENS CAROLINIANUS (Steud.) Henr. Common in dry, open woods.
TRIDENS FLAVUS (L.) Hitchc. var. CHAPMANII (Small) Shinners. [Sieglingia chapmanii Small] Purple Top. Common in woodland margins, roadsides.
TRIPLASIS AMERICANA Beauv. [Sieglingia americana (Beauv.) Kuntze] Rare in dry, sandy open area.
*TRITICUM AESTIVUM L. Wheat. Rare on waste ground. N.

CYPERACEAE

BULBOSTYLIS BARBATA (Rottb.) Clarke. Infrequent in moist, sandy areas.
BULBOSTYLIS CILIATIFOLIA (Ell.) Fern. [Stenophyllus ciliatifolius (Ell.) Mohr] Common in dry, sandy areas.
CAREX ALBOLUTESCENS Schwein. Sedge. Common in low, moist areas.
**CAREX AMPHIBOLA Steud. Infrequent in low, swampy woods.

CAREX ATLANTICA Bailey. Infrequent in swamp forest.
CAREX COMPLANATA Torr. & Hook. [C. hirsuta Willd.] Infrequent in low woods.
CAREX DEBILIS Michx. Common in low woods.
CAREX ELLIOTTII Schwein. and Torr. Infrequent in low woods.
CAREX FESTUCACEA Schkuhr. Infrequent in low woods.
CAREX FOLLICULATA L. var. AUSTRALIS Bailey. Infrequent in low woods.
CAREX GLAUCESCENS Ell. Infrequent in wet savannahs.
CAREX INTUMESCENS Rudge. Infrequent in open, wet areas.
CAREX LEAVENWORTHII Dewey. Infrequent along shady roadside.
CAREX LEPTALEA Wahl. var. HARPERI (Fern.) Stone. Infrequent in low woods.
CAREX LURIDA Wahl. Common in open wet areas.
CAREX VENUSTA Dewey. [C. oblita Steud.] Infrequent in low woods.
CYPERUS COMPRESSUS L. Common in moist, disturbed places.
CYPERUS CUSPIDATUS HBK. Rare weed on campus lawn.
CYPERUS ESCULENTUS L. Nut Grass. Common on roadsides, lawns.
CYPERUS FILICULMIS Vahl. Infrequent in lawns, cultivated places.
CYPERUS GLOBULOSUS Aublet. [C. echinatus (Ell.) Wood.] Infrequent in sandy wasteplaces.
CYPERUS HASPAN L. Infrequent in moist places.
CYPERUS IRIA L. Rare in wet, open areas. N.
CYPERUS ODORATUS L. [C. speciosus Vahl.] Common in wet open areas, ditches.
CYPERUS POLYSTACHYOS Rottb. var. TEXENSIS (Torr.) Fern. [C. microdontus Torrey] Infrequent in low, disturbed places.
**CYPERUS PSEUDOVEGETUS Steud. Infrequent in wet areas.
CYPERUS RETROFRACTUS Engelm. ex Boeck. Infrequent in dry woods.
CYPERUS RETRORSUS Chapm. [C. cylindricus (Ell.) Britton] Common in cultivated grounds, pinelands.
CYPERUS ROTUNDUS L. Nut Grass. Common in moist, cultivated grounds. N.
CYPERUS SESQUIFLORUS (Torr.) Mattf. & Kukenth. [Kyllinga sesquiflora Torr.] Common in ditches, moist lawns.
CYPERUS STRIGOSUS L. Common in low waste places.
CYPERUS TENUIFOLIUS (Stued.) Dandy. [Killinga pumila Michx.] Infrequent in low fields.
DULICHIUM ARUNDINACEUM (L.) Britt. Infrequent in swamp.
*ELEOCHARIS EQUISETOIDES (Ell.) Torr. [Included by Mohr under E. interstincta] Spike-rush. Rare on border of stream.
ELEOCHARIS FLAVESCENS (Poir.) Urban. [E. ochreata (Nees) Steud and E. olivacea Torr.] Infrequent in wet pinelands, borders of ponds and stream.
ELEOCHARIS MICROCARPA Torr. Infrequent along border of ponds and stream.
ELEOCHARIS OBTUSA (Willd.) Schult. [E. ovata (Roth.) Roem. & Schult.] Common along border of ponds and stream.
*ELEOCHARIS ROBBINSII Oakes. Rare, partly submerged along stream bank.
ELEOCHARIS TUBERCULOSA (Michx.) R. & S. Common in wet open areas and along border of ponds and stream.
*FIMBRISTYLIS ANNUA (All.) R. and S. Infrequent in moist grassy areas.
FIMBRISTYLIS AUTUMNALIS (L.) R. and S. Common in moist, open areas.
FIMBRISTYLIS DICHOTOMA (L.) Vahl. Infrequent in moist open areas.
*FIMBRISTYLIS MILIACEA (L.) Vahl. Common in moist, open areas. N.
*FIMBRISTYLIS TOMENTOSA Vahl. Infrequent in moist, open areas.
FUIRENA SCIRPOIDEA Michx. Rare along stream bank.
FUIRENA SQUARROSA Michx. Umbrella-grass. Common in wet open areas.
*PSILOCARYA NITENS (Vahl) Wood. Bald Rush. Infrequent in moist open sandy areas.
RHYNCHOSPORA CADUCA Ell. Beak-rush. Rare in open marshy area.
RHYNCHOSPORA CEPHALANTHA Gray. [R. axillaris (Lam.) Britton]
*RHYNCHOSPORA CHALAROCEPHALA Fern. & Gale. Infrequent in open marshy area.
RHYNCHOSPORA CHAPMANII M.A. Curtis. Rare in open marshy area.
RHYNCHOSPORA CILIARIS (Michx.) Mohr. Infrequent in moist open areas.

RHYNCHOSPORA CORNICULATA (Lam.) Gray. Common in wet open areas.
RHYNCHOSPORA FASCICULARIS (Michx.) Vahl. Infrequent in open marshy areas.
RHYNCHOSPORA GLOBULARIS (Chapm.) Small. [Rhynchospora cymosa (Willd.) Ell. and R. cymosa globularis Chap.] Infrequent on margin of ponds.
RHYNCHOSPORA GLOMERATA (L.) Vahl. Common in open marshy area.
RHYNCHOSPORA GRACILENTA Gray. Infrequent in wet open areas.
RHYNCHOSPORA GRAYI Kunth. Uncommon on dry sandy roadside.
*RHYNCHOSPORA HARVEYI W. Boott. Infrequent in open marshy area.
RHYNCHOSPORA INTERMIXTA E. Wright. [Rhynchospora pusilla Chapm.] Rare in open marshy areas.
*RHYNCHOSPORA MACROSTACHYA Torrey. Infrequent along open margins of pond.
RHYNCHOSPORA MEGALOCARPA Gray. Infrequent in dry, sandy pinelands.
RHYNCHOSPORA RARIFLORA (Michx.) Ell. Uncommon along small stream.
SCIRPUS CYPERINUS (L.) Kunth. Bulrush. Common in moist areas.
SCIRPUS ETUBERCULATUS (Steud.) Kuntz. [S. cylindricus (Torr.) Britton] Rare on margin of pond.
SCIRPUS KOILOLEPIS (Steud.) Gleason. [S. carinatus (Hook. and Arn.) Gray] Rare in wet, open areas.
SCLERIA CILIATA Michx. Nut-rush. Common in dry, open woods.
SCLERIA RETICULARIS Michx. var. pubescens Britton. [S. torreyana Walp.] Infrequent in moist pinelands.
SCLERIA TRIGLOMERATA Michx. Common in sandy pinelands, pond margins.

ARECACEAE

SERENOA REPENS (Bartr.) Small. [S. serrulata (Michx.) Benth. and Hook.] Saw Palmetto. Common in low pinelands.

ARACEAE

*COLOCASIA ESCULENTA Schott. Taro. Rare in ditches near park. N.
ORONTIUM AQUATICUM L. Golden Club. Common along margins of stream and ponds.
PELTANDRA SAGITTAEFOLIA (Michx.) Morong. Rare in open moist area along stream.
PELTANDRA VIRGINICA (L.) Kunth. Infrequent in swamps.

LEMNACEAE

*LEMNA PERPUSILLA Torrey. [possibly included by Mohr under L. Minor L.] Rare along margins of pond.

MAYACACEAE

MAYACA AUBLETTI Michx. Bog Moss. Common in wet, sandy open areas.
MAYACA FLUVIATILIS Aubl. [included by Mohr, perhaps judiciously under M. aubletii] Infrequent in wet, sandy open areas.

XYRIDACEAE

XYRIS AMBIGUA Beyr. Yellow-eyed Grass. Common in moist pinelands.
XYRIS CAROLINIANA Walt. [X. flexuosa Muhl.] Common in moist pinelands.
*XYRIS DIFFORMIS Chapm. var. DIFFORMIS. [probably included by Mohr in X. communis Kunth.] Infrequent on pond margins.
XYRIS FIMBRIATA Ell. Rare in wet pine barrens.
XYRIS IRIDIFOLIA Chapm. Infrequent in openings in swamp.
XYRIS JUPICAI Rich. [X. communis Kunth.] Common in moist pinelands pond margins.

ERIOCAULACEAE

ERIOCAULON DECANGULARE L. Pipewort. Infrequent along pond margins.
LACHNOCAULON ANCEPS (Walt.) Morong. Bog-buttons. Infrequent in moist, open sandy areas.

BROMELIACEAE

TILLANDSIA USNEOIDES L. Spanish Moss. Infrequent epiphyte.

COMMELINACEAE

*ANEILEMA NUDIFLORUM (L.) Kunth. Infrequent in moist cultivated sites. N.
COMMELINA DIFFUSA Burm. [C. nudiflora L.] Dayflower. Infrequent in waste places.
COMMELINA ERECTA L. Common in waste places.
TRADESCANTIA HIRSUTICAULIS Small. Rare in dry woods.
TRADESCANTIA OHIENSIS Raf. [T. reflexa Raf.] Spiderwort. Infrequent in moist roadsides, waste places.

JUNCACEAE

JUNCUS ACUMINATUS Michx. Rush. Common in moist open areas.
JUNCUS BIFLORUS Ell. [J. marginatus aristulatus (Michx.) Coville] Infrequent in moist, open areas.
*JUNCUS CORIACEUS Mackenzie. Rare along stream and pond margins.
JUNCUS DEBILIS Gray. [J. acuminatus debilis (Gray) Engelm.] Infrequent in moist, open areas.
JUNCUS DICHOTOMUS Ell. common in moist, open areas.
JUNCUS DIFFUSISSIMUS Buckl. Common in wet areas along stream and ponds.
JUNCUS EFFUSUS L. Infrequent in edges of swamp and ponds.
JUNCUS ELLIOTTII Chapm. Rare in wet, open areas.
JUNCUS GYMNOCARPUS Coville. Rare in wet, open areas.
JUNCUS MARGINATUS Rostk. Common in moist, sandy soil.
JUNCUS POLYCEPHALUS Michx. Infrequent along stream and ponds.
JUNCUS REPENS Michx. Infrequent along pond margins.
JUNCUS SCIRPOIDES Lam. Common in moist, open areas.
JUNCUS TENUIS Willd. Common in waste and cultivated grounds.
JUNCUS TRIGONOCARPUS Steud. Infrequent in moist, open areas.
*JUNCUS VALIDUS Coville. Infrequent in moist, open areas.

LILIACEAE

ALETRIS AUREA Walt. Infrequent in moist pinelands.
ALETRIS FARINOSA L. Unicorn-root. Common in dry pinelands.
ALLIUM BIVALVE (L.) Kuntze. [Nothoscordum bivalve (L.) Britton] False Garlic. Common in roadsides, cultivated and waste grounds.
ALLIUM CANADENSE L. Wild Onion. Common on roadsides, waste grounds.
*ALLIUM INODORUM Aiton. Uncommon in disturbed areas at park. N.
AMIANTHIUM MUSCAETOXICUM (Walt.) Gray. [Chrosperma muscaetoxicum (Walt.) Kuntze] Fly Poison. Common on wooded slopes.
CHAMAELIRIUM LUTEUM (L.) Gray. Blazing Star. Rare in mesic woods.
SMILAX AURICULATA Walt. Greenbrier, Catbrier. Common in dry, open woods.
SMILAX BONA-NOX L. Common in disturbed areas, roadsides.
SMILAX GLAUCA Walt. Common along border of swamp forest.
SMILAX LAURIFOLIA L. Common in swamp forest.
SMILAX PUMILA Walt. Common in dry, open woods.
**SMILAX ROTUNDIFOLIA L. Rare in moist area along creek.
SMILAX SMALLII Morong. [S. lanceolata L.] Common in mesic woods.
SMILAX WALTERI Pursh. Rare in moist areas along creek.
TOFIELDIA RACEMOSA (Walt.) BSP. False Asphodel. Infrequent in moist pinelands.
YUCCA ALOIFOLIA L. Spanish—Bayonet. Rare in woodland border.
YUCCA FILAMENTOSA L. Bear-grass. Infrequent in dry, open woods.

DIOSCOREAECEAE

DIOSCOREA VILLOSA L. var. VILLOSA. Wild Yam. Rare along border of swamp forest.

AMARYLLIDACEAE

CRINUM BULBISPERUM Milne-Redhead & Schweickerdt. [C. americanum L.] Rare along open stream bank.

*HYPOXIS MICRANTHA Pollard. Yellow Star-grass. Common in dry pinewoods.
*HYPOXIS SESSILIS L. Infrequent in dry woods.
ZEPHYRANTHES ATAMASCO (L.) Herb. [Atamosco atamasco (L.) Greene] Rain Lily. Rare in roadside ditch.

HAEMODORACEAE

LACHNANTHES CAROLINIANA (Lam.) Dandy. [Gyrotheca capitata (Walt.) Morong] Redroot. Infrequent in moist pinelands.

IRIDACEAE

*IRIS FULVA Ker. Red Iris. Rare along creek.
IRIS HEXAGONA Walter. Blue Flag. Infrequent along pond.
IRIS VERNA L. Dwarf Iris. Common in dry, open woods.
SISYRINCHIUM ARENICOLA Bichn. [S. fuscatum Bicknell and S. carolinianum Bicknell] Blue-eyed Grass. Common in dry, sandy open woods.
*SISYRINCHIUM EXILE Bicknell. Frequent lawn weed.
**SISYRINCHIUM MUCRONATUM Michx. var. ATLANTICUM (Bicknell) Ahles. Common in dry, sandy woods.
SISYRINCHIUM ROSULATUM Michx. Common in dry, sandy waste grounds, lawns.

BURMANNIACEAE

APTERIA APHYLLA (Nutt.) Barnhart. [A. setacea Nutt.] Infrequent in low woods.
BURMANNIA CAPITATA (Gmelin) Martius. Infrequent and inconspicuous in wet, sandy areas along stream.

ORCHIDACEAE

CALOPOGON PULCHELLUS (Salisb.) R.Br. [Limodorum tuberosum L.] Grass Pink. Common in moist pinelands.
CLEISTES DIVARICATA (L.) Ames. [Pogonia divaricata (L.) R. Br.] Rosebud Orchid. Rare in moist woodlands.
HABENARIA CILIARIS (L.) R. Br. Yellow Fringed Orchid. Infrequent in open, marshy area.
HABENARIA REPENS Nutt. Water Spider Orchid. Rare on border of lake.
POGONIA OPHIOGLOSSOIDES (L.) Ker-Gawl. Rose Pogonia. Infrequent in wet savannah.
SPIRANTHES GRACILIS (Bigel.) Beck var. FLORIDANA (Wherry) Correll. [Gyrostachys gracilis (Bigel.) Kuntze] Infrequent in low pinelands.
SPIRANTHES PRAECOX (Walt.) S. Wats. [Gyrostachys praecox (Walt.) Kuntze] Grass-leaved Ladies Tresses. Infrequent in moist pinelands.
*SPIRANTHES VERNALIS Engelm. and Gray. Spring Ladies Tresses. Rare in open, grassy area.

SAURURACEAE

SAURURUS CERNUUS L. Lizard's Tail. Rare along stream banks.

SALICACEAE

POPULUS DELTOIDES Marsh. Cottonwood. Infrequent along stream banks.
SALIX NIGRA Marsh. Black Willow. Common on stream banks and other moist areas.

MYRICACEAE

MYRICA CERIFERA L. Wax Myrtle. Common in moist pinelands.
MYRICA HETEROPHYLLA Raf. [M. carolinensis Mill.] Bayberry. Infrequent in moist pinelands and along margins of bay forest.
MYRICA INODORA Bartram. Rare along margin of bay forest.

JUGLANDACEAE

CARYA ILLINOENSIS (Wang.) K. Knock. [Hicoria pecan (Marsh.) Britton] Pecan. Rare on roadsides, escaped.
CARYA TOMENTOSA (Poir.) Nutt. [Hicoria alba (L.) Britton] Mockernut Hickory. Common in dry, open woods.

FAGACEAE

*CASTANEA ALNIFOLIA Nutt. var. FLORIDANA Sarg. Florida Chinquapin. Rare in dry woods.

CASTANEA PUMILA (L.) Mill. Chinquapin. Common in dry, sandy upland woods.

QUERCUS ALBA L. White Oak. Rare in mesic woodland.

QUERCUS FALCATA Michx. [Q. digitata (Marsh.) Sudworth] Southern Red Oak, Spanish Oak. Common in dry, open woods.

*QUERCUS GEMINATA Small. Dwarf Live Oak. Infrequent in dry, upland woods.

QUERCUS HEMISPHERICA Bartr. [Q. laurifolia Michx.] Laurel Oak. Common in dry, open woods to swamp margins.

QUERCUS INCANA Bartr. [Q. brevifolia (Lam.) Sargent] Blue-Jack Oak. Common in dry, sandy soil.

QUERCUS LAEVIS Walt. [Q. catesbaei Michx.] Turkey Oak. Common in dry, sandy areas.

*QUERCUS MARGARETTA Ashe. Scrubby Post Oak. Common in dry, open woods.

QUERCUS NIGRA L. Water Oak. Common in borders of low woods.

QUERCUS STELLATA Wang. Post Oak. Rare in mesic woods.

QUERCUS VIRGINIANA Mill. Live Oak. Infrequent in open woods.

MORACEAE

BROUSSONETIA PAPYRIFERA (L.) Vent. Paper Mulberry. Rare, escaped near railroad tracks. N.

*FATOUA VILLOSA (Thunb.) Nakai. Rare weed in cultivated grounds. N.

MORUS ALBA L. White Mulberry. Rare in cultivated and waste grounds. N.

MORUS RUBRA L. Red Mulberry. Infrequent in low woods.

CANNABACEAE

BOEHMERIA CYLINDRICA (L.) Sw. False Nettle. Common in low woods along stream.

LORANTHACEAE

PHORADENDRON SEROTINUM (Raf.) M.C. Johnston. Mistletoe. Infrequent parasite on deciduous trees.

POLYGONACEAE

POLYGONUM HYDROPIPEROIDES Michx. Smart-weed. Common along stream banks.

POLYGONUM LAPATHIFOLIUM L. Infrequent along stream banks.

POLYGONUM PENSYLVANICUM L. Infrequent in moist disturbed areas and along stream banks.

POLYGONUM PUNCTATUM Ell. Common in swamp forest.

**POLYGONUM SETACEUM Baldw. ex Ell. Infrequent in swamp forest.

RUMEX CRISPUS L. Sour Dock. Infrequent on moist roadsides, open stream banks. N.

RUMEX HASTATULUS Balw. ex Ell. Wild Sorrel. Common on roadsides, waste places.

CHENOPODIACEAE

CHENOPODIUM ALBUM L. Pigweed. Rare in waste places.

CHENOPODIUM AMBROSIOIDES L. Mexican-tea. Infrequent in waste places, roadsides. N.

AMARANTHACEAE

ALTERNANTHERA PHILOXEROIDES (Mart.) Griseb. [Telanthera philoxeroides acutifolia Moq.] Alligator-weed. Frequent along pond margins. N.

AMARANTHUS HYBRIDUS L. Pigweed. Rare on moist roadside.

AMARANTHUS SPINOSUS L. Thorny amaranth. Infrequent along roadside. N.

*AMARANTHUS VIRIDIS L. Rare weed, in flower bed.

NYCTAGINACEAE

*MIRABILIS JALAPA L. Four-o'clock. Rare in waste places. N.

PHYTOLACCA AMERICANA L. [P. decandra L.] Pokeweed. Common in waste grounds.

AIZOACEAE

MOLLUGO VERTICILLATA L. Carpet-weed. Infrequent in cultivated and waste grounds. N.

PORTULACACEAE

PORTULACA OLERACEA L. Rare in cultivated grounds. N.

CARYOPHYLLACEAE

**ARENARIA SERPYLLIFOLIA L. Rare along roadside. N.

CERASTIUM GLOMERATUM Thuillier. [C. viscosum L.] Mouse-Ear Chickweed. Common in lawns, waste places and along roadsides.

SAGINA DECUMBENS (Ell.) T. & G. Pearlwort. Common on lawn, waste places.

SILENE ANTIRRHINA L. Sleepy Catchfly. Rare along dry, sandy roadside.

STELLARIA MEDIA (L.) Cyrill. [Alsine media L.] Chickweed. Common in cultivated grounds, waste places. N.

NYMPHAEACEAE

NYMPHAEA ODORATA Aiten. [Castalia odorata (Dryand.) Woodv. & Wood] Water-lily. Common in pond at park.

CABOMBACEAE

BRASENIA SCHREBERI Gmel. [B. purpurea (Michx.) Casp.] Water Shield. Infrequent, floating in pond at park.

RANUNCULACEAE

CLEMATIS CRISPA L. Leather-Flower. Infrequent along margins of swamp.

*CLEMATIS DIOSCOREIFOLIA Levl. and Vaniot. Rare in open, disturbed area by creek. N.

RANUNCULUS MURICATUS L. Buttercup. Infrequent in ditches, wet meadows.

RANUNCULUS PUSILLUS Poir. Infrequent in moist, open areas.

XANTHORHIZA SIMPLICISSIMA Marshall. [Zanthorhiza apiifolia L'Her.] Rare along shaded stream banks.

MENISPERMACEAE

**COCCULUS CAROLINUS (L.) DC. [Cebatha carolina (L.) Britton] Coralbeads. Rare in cultivated ground.

MAGNOLIACEAE

ILLICIUM FLORIDANUM Ellis. Star Anise. Common in bay forest as understory shrubs.

LIRIODENDRON TULIPIFERA L. Tulip Tree. Common in low woods.

MAGNOLIA GRANDIFLORA L. [M. foetida (L.) Sargent] Southern Magnolia. Infrequent along border of swamp forest.

MAGNOLIA VIRGINIANA L. Sweet Bay. Common in swamp forest.

ANNONACEAE

ASIMINA PARVIFLORA (Michx.) Dunal. Dwarf Pawpaw. Common in sandy woods.

CALYCANTHACEAE

CALYCANTHUS FLORIDUS L. [Butneria florida (L.) Dearney] Sweet Shrub. Rare in mesic woodland.

LAURACEAE

*CINNAMONUM CAMPHORA (L.) Nees. and Eberm. Camphor-Tree. Infrequent along border of woods. N.

PERSEA PALUSTRIS (Raf.) Sarg. [P. pubescens (Pursh) Sargent] Red Bay. Common in swamp forest and along its margins.

SASSAFRAS ALBIDUM (Nutt.) Nees. [S. sassafras (L.) Karst.] Sassafras. Common in rolling pinelands.

FUMARIACEAE

CORYDALIS MICRANTHA (Engelm.) Gray ssp. AUSTRALIS (Chapman) Ownbey. Infrequent along moist roadside.

BRASSICACEAE

BRASSICA NAPUS L. [B. campestris L.] Turnip. Rare in disturbed open areas. N.

CAPSELLA BURSA-PASTORIS (L.) Medic. [Bursa bursa-pastoris (L.) Britton] Shepherd's purse. Common weed around dwellings and lawns. N.

*CARDAMINE HIRSUTA L. [probably included by Mohr under C. pennsylvanica Muhl.] Bitter Cress. Rare weed in disturbed habitats.

CORONOPUS DIDYMUS (L.) Sm. Infrequent on moist roadsides. N.

LEPIDIUM VIRGINICUM L. Peppergrass. Common in cultivated and waste grounds.

*RAPHANUS RAPHANISTRUM L. Occasional along roadsides.

RORIPPA WALTERI (Ell.) Mohr. Yellow Cress. Infrequent in wet meadows.

SIBARA VIRGINICA (L.) Rollins [Arabis virginica (L.) Trelease] Infrequent in disturbed areas.

DROSERACEAE

DROSERA CAPILLARIS Poir. Sundew. Common in moist pinelands.

DROSERA INTERMEDIA Hayne. Infrequent in moist pinelands, border of ponds.

DROSERA LEUCANTHA Shinners. [D. brevifolia Pursh] Common in moist pinelands, border of ponds.

SAXIFRAGACEAE

DECUMARIA BARBARA L. Climbing Hydrangea. Common in swamp forest.

ITEA VIRGINICA L. Virginia Willow. Common in low woods and along stream.

LEPUROPETALON SPATHULATUM (Muhl.) Ell. Infrequent and inconspicuous in damp, grassy areas.

HAMAMELIDACEAE

HAMAMELIS VIRGINIANA L. Witch-hazel. Common in moist woods.

LIQUIDAMBAR STYRACIFLUA L. Sweet-gum. Infrequent in mesic woods.

PLATANACEAE

PLATANUS OCCIDENTALIS L. Sycamore. Infrequent in moist sand along creek.

ROSACEAE

AGRIMONIA PUBESCENS Wallr. var. MICROCARPA Wallr. [A. pumila Muhl.] Agrimony. Rare in upland mixed woods.

AMELANCHIER ARBOREA (Michx. F.) Fern. June-berry. Infrequent near stream banks.

CHRYSOBALANUS OBLONGIFOLIUS Michx. Gopher Apple. Common in dry, open woods.

DUCHESNEA INDICA (Andr.) Focke. Indian Strawberry. Infrequent on roadsides, waste places. N.

MALUS ANGUSTIFOLIA (Ait.) Michx. [Pyrus angustifolia Ait.] Crab Apple. Rare along path in mesic woods.

PRUNUS ANGUSTIFOLIA Marsh. Chickasaw Plum. Common on roadsides, woodland borders.

PRUNUS CAROLINIANA Ait. Laurel Cherry. Rare on waste grounds, escaped.

PRUNUS PERSICA (L.) Batsch. Peach. Rare on roadsides, escaped. N.

PRUNUS SEROTINA Ehrh. Black Cherry. Common in woodlands, waste grounds.

*PYRACANTHA CRENATO-SERRATA Rehd. Rare, escaped in open waste grounds. N.

ROSA BRACTEATA Wendl. Macartney Rose. Rare in roadside thicket, escaped. N.

ROSA LAEVIGATA Michx. Cherokee Rose. Infrequent along woodland margins, roadside. N.

ROSA MULTIFLORA Thunb. Rose. Rare in waste places; former home sites. N.

*ROSA WICHURAIANA Crepin. Memorial Rose. Rare along railroad embankments. N.

*RUBUS BETULIFOLIUS Small. [probably corresponds at least partly to R. argutus Link in Mohr] Blackberry. Common on roadsides, and in moist pinelands.

RUBUS CUNEIFOLIUS Pursh. Infrequent on margins of ponds.
**RUBUS FLAGELLARIS Willd. Dewberry. Rare in open waste places.
RUBUS TRIVIALIS Michx. Common on dry roadsides, waste places.
SORBUS ARBUTIFOLIA (L.) Heynh. [Aronia arbutifolia (L.) Ell.] Chokeberry. Common in wet savannahs.

FABACEAE

ALBIZIA JULIBRISSIN Durazz. Mimosa. Common in open woods, roadsides. N.
APIOS AMERICANA Medic. [Apios apios (L.) MacMillan] Groundnut. Infrequent along stream.
ASTRAGALUS VILLOSUS Michx. Rare along dry sandy roadside.
CASSIA FASCICULATA Michx. [Chamaecrista fascicularis (Michx.) Greene] Partridge Pea. Common on roadsides, woody places.
CASSIA NICTITANS L. [Chamaecrista nictitans (L.) Moench and Chamaecrista multipinnata (Pollard) Greene] Wild Sensitive Plant. Common on roadsides, weedy places.
CASSIA OBTUSIFOLIA L. [C. tora L.] Sicklepod. Infrequent on roadsides. N.
CASSIA OCCIDENTALIS L. Coffee Senna. Infrequent on roadsides. N.
CENTROSEMA VIRGINIANUM (L.) Benth. [Bradburya virginiana (L.) Kuntze] Butterfly Pea. Common in dry, open woods.
CLITORIA MARIANA L. Common in dry open woods.
CROTALARIA ANGULATA Mill. [C. rotundifolia (Walt.) Poir.] Rattlebox. Common in dry, open woods.
*CROTALARIA INTERMEDIA Kotschy. Rare on roadside. N.
CROTALARIA PURSHII DC. Infrequent in open woods.
**CROTALARIA SAGITTALIS L. Rare in open woods.
*CROTALARIA SPECTABILIS Roth. Common on roadsides.
DAUBENTONIA PUNICEA (Car.) DC. Infrequent on border of bay forest and along stream.
DESMANTHUS ILLINOENSIS (Michx.) Mac. M. [Acuan illinoense (Michx.) Kuntze] Rare in waste places.
DESMODIUM CILIARE (Muhl. ex Willd.) DC. [Meibomia obtusa (Muhl.) Vail] Beggar Lice. Common in pinewoods, lawns.
DESMODIUM GLABELLUM (Michx.) DC. [Meibomia dillenii (Darl) Kuntze] Common on dry roadsides, open woods.
**DESMODIUM LAEVIGATUM (Nutt.) DC. [Meibomia laevigata (Nutt.) Kuntze] Common in dry, open woods.
DESMODIUM LINEATUM DC. [Meibomia arenicola Vail] Common in dry, open woods.
DESMODIUM PANICULATUM (L.) DC. [Meibomia paniculata (L.) Kuntze] Common in dry, open woods.
DESMODIUM TENUIFOLIUM T. & G. [Meibomia tenuifolia Torr. and (Gray) Kuntze] Infrequent in moist areas.
*DESMODIUM TORTUOSUM (Sw.) DC. Common on dry roadsides, waste places N.
DESMODIUM VIRIDIFLORUM (L.) DC. [Meibomia vividiflora (L.) Kuntze] Infrequent on roadsides, open woods.
GALACTIA ERECTA (Walt.) Vail. Milk Pea. Common in dry, open woods.
*GALACTIA MOLLIS Michx. Common in dry, open woods.
GALACTIA VOLUBILIS (L.) Britt. Common in dry, open woods.
GLOTTIDIUM VESICARIUM (Jacq.) Harper. Bladder-pod. Infrequent in moist, open areas near stream. N.
LESPEDEZA CAPITATA Michx. Common in dry, sandy roadsides and woodland borders.
*LESPEDEZA CUNEATA (Dumont) G. Don. Sericea. Rare on dry roadside. N.
LESPEDEZA HIRTA (L.) Hornem. Common in dry, open woods.
LESPEDEZA REPENS (L.) Bart. Common in dry, upland woods, roadsides.
LESPEDEZA STRIATA (Thunb.) H. & A. Japanese Clover. Common in cultivated and waste grounds. N.
**LESPEDEZA STUEVEI Nutt. Infrequent in dry, open sites.
LESPEDEZA VIRGINICA (L.) Britt. Common in dry, open margins of wood, roadsides.
LUPINUS DIFFUSUS Nutt. Lupine. Common in dry, open woods.
MELILOTUS ALBA Desr. White Sweet Clover. Rare on roadsides, waste places. N.
MELILOTUS INDICA (L.) All. Sour Clover. Rare on roadsides. N.

MEDICAGO LUPULINA L. Black Medick. Common on roadsides, lawns, and waste places. N.

PETALOSTEMUM GRACILIS Nutt. [Kuhnistera gracilis (Nutt.) Kuntze] Rare in pinelands.

PETALOSTEMUM CAROLINIANUM (Lam.) Sprague. [Kuhnistera pinnata (Walt.) Kuntze] Summer Farewell. Common in dry, open woods.

*PUERARIA LOBATA (Willd.) Chivi. Kudzu. Common on roadsides, waste grounds. N.

ROBINIA PSEUDO-ACACIA L. Back Locust. Rare in woodland borders, probably escaped.

RHYNCHOSIA GALACTIOIDES Endl. Common in dry, open woods.

RHYNCHOSIA RENIFORMIS DC. [R. simplicifolia (Walt.) Wood.] Common in dry, open woods.

RHYNCHOSIA TOMENTOSA (L.) H. and A. [R. erecta (Walt.) DC.] Rare along dry, sandy roadside.

SCHRANKIA MICROPHYLLA (Soland ex Sm.) Macbr. [Morongia angustata (Torr. and Gray) Britton] Sensitive Brier. Common in dry, open woods.

SESBANIA EXALTATA (Raf.) A. W. Hill. [Sesban macrocarpum Muhl.] Infrequent in moist, disturbed areas.

STYLOSANTHES BIFLORA (L.) BSP. Pencil Flower. Common in dry, open woods, roadsides.

STROPHOSTYLES HELVOLA (L.) Ell. [Phaseolus helvolus L.] Common in dry, open woods, roadsides.

STROPHOSTYLES UMBELLATA (Muhl. ex Willd.) Britton. [Phaseolus umbellatus (Muhl) Britton] Rare in dry, open woods.

TEPHROSIA CHRYSOPHYLLA Pursh. [Cracca chrysophylla (Pursh) Kuntze] Common in dry, open woods.

*TEPHROSIA FLORIDA (F.G. Dietr.) C.E. Wood. [possibly same as Cracca smallii (Small) Vail in Mohr] Common in dry, open woods.

TEPHROSIA SPICATA (Walt.) T. & G. [Cracca spicata (Walt.) Kuntze] Rare in pinelands.

**TRIFOLIUM CAMPESTRE Schreb. [T. procumbens L.] Low Hop Clover. Common on lawns, waste places. N.

TRIFOLIUM CAROLINIANUM Michx. Clover. Common on roadsides, cultivated and waste grounds.

**TRIFOLIUM DUBIUM Sibth. Hop Clover. Infrequent in cultivated and waste places. N.

*TRIFOLIUM INCARNATUM L. Crimson Clover. Infrequent on roadsides. N.

TRIFOLIUM REPENS L. White Clover. Common in cultivated and waste grounds. N.

TRIFOLIUM RESUPINATUM L. Persian Clover. Rare along roadside. N.

*VICIA ANGUSTIFOLIA Reich. Vetch. Common on roadsides, cultivated and waste places. N.

*VICIA DASYCARPA Ten. Infrequent in waste places. N.

VICIA TETRASPERMA (L.) Moench. Common in cultivated and waste grounds. N.

*WISTERIA SINENSIS (Sims) Sweet. Wisteria. Infrequent on roadsides, old homesites. N.

ZORNIA BRACTEATA Walt. ex Gmel. Infrequent in dry, sandy soil.

LINACEAE

LINUM STRIATUM Walt. Common in moist places.

LINUM VIRGINIANUM L. var. MEDIUM Planch. Common in dry, open areas.

OXALIDACEAE

*OXALIS DILLENII Jacquin. Wood Sorrel. Common in cultivated and waste grounds.

*OXALIS RUBRA St. Hil. Infrequent in disturbed, shady sites. N.

OXALIS STRICTA L. Infrequent in cultivated and waste ground.

OXALIS VIOLACEA L. Violet. Infrequent in mesic woods.

GERANIACEAE

GERANIUM CAROLINIANUM L. Cranesbill. Common in cultivated and waste grounds.

MELIACEAE

MELIA AZEDARACH L. China-berry. Commonly cultivated, occasionally escaped on woodland borders. N.

POLYGALACEAE

POLYGALA BREVIFOLIA Nutt. Milkwort. Rare in wet pinelands.
POLYGALA CRUCIATA L. Infrequent in moist, open areas.
POLYGALA GRANDIFLORA Walt. Common in dry, open woods.
POLYGALA INCARNATA L. Infrequent in dry, open disturbed woods.
POLYGALA LUTEA L. Infrequent in open, marshy area.
POLYGALA MARIANA Mill. Infrequent in moist, open places.
POLYGALA NANA (Michx.) DC. Common in open, sandy woods.
POLYGALA RAMOSA Ell. Infrequent in moist, open places.
POLYGALA VERTICILLATA L. Infrequent in dry, open woods.

EUPHORBIACEAE

ACALYPHA GRACILENS Gray. Three-seeded Mercury. Common on roadsides, cultivated and waste grounds.
*ACALYPHA RHOMBOIDEA Raf. Rare in open area along stream.
*ACALYPHA SETOSA A. Rich. Rare in waste places. N.
*ALEURITES FORDII Hemsley. Tung Tree. Rarely escaped along stream and on roadside. N.
CNIDOSCOLUS STIMULOSUS (Michx.) Engelm. & Gray. [Jatropha stimulosa Michx.] Spurge Nettle. Common in dry, open woods.
CROTON CAPITATUS Michx. Common on roadsides and waste places.
CROTON GLANDULOSUS L. var. SEPTENTRIONALIS Muell-Arg. Common on roadsides and waste places.
**CROTONOPSIS LINEARIS Michx. Infrequent on roadside, woodland borders.
EUPHORBIA COROLLATA L. Flowering Spurge. Common in dry, open woods.
*EUPHORBIA HETEROPHYLLA L. Painted Leaf. Rare on railroad right of way.
EUPHORBIA HIRTA L. [probably same as E. pilulifera discolor Engelm in Mohr] Common in cultivated and waste ground.
EUPHORBIA MACULATA L. Eyebane. Infrequent in waste grounds.
EUPHORBIA SUPINA Raf. [E. humistrata Engelm.] Common on roadsides, waste places.
PHYLLANTHUS CAROLINIENSIS Walt. Common in cultivated and waste grounds.
*PHYLLANTHUS URINARIA L. Common in cultivated and waste grounds. N.
SAPIUM SEBIFERUM (L.) Rox. Chinese Tallow Tree (Locally known as Popcorn Tree). Infrequent escaped in waste grounds. N.
STILLINGIA SYLVATICA Garden. Common in dry, open sandy woods.
*TRAGIA SMALLII Shinners. Common in dry, open woods.

CALLITRICHACEAE

**CALLITRICHE DEFLEXA A. Braun. [C. austinii Engelm.] Water Starwort. Infrequent and inconspicuous in damp field.

ANACARDIACEAE

RHUS COPALLINA L. Dwarf or Winged Sumac. Common in dry, open woods.
RHUS GLABRA L. Smooth or Common Sumac. Rare on stream bank.
RHUS RADICANS L. Poison Ivy. Common in mesic woods, waste places.
RHUS TOXICODENDRON L. Poison Oak. Infrequent in dry, open woods.
RHUS VERNIX L. Poison Sumac. Common in wet pinelands near stream.

CYRILLACEAE

CLIFTONIA MONOPHYLLA (Lam.) Britton. Black Titi. Common in low pinelands and border of bay forest.
CYRILLA RACEMIFLORA L. Swamp Cyrilla, Titi. Common in border of bay forest.

AQUIFOLIACEAE

ILEX AMBIGUA (Michx.) Torr. [I. caroliniana Walt.] Holly. Infrequent in upland pinewoods.
ILEX CASSINE L. Rare in moist woodland borders.
ILEX CORIACEA (Pursh) Chapm. Large Gallberry. Common understory shrub in bay forest.
ILEX GLABRA (L.) Gray. Bitter Gallberry. Common in wet pinelands.

ILEX OPACA Ait. Holly. Infrequent in low swampy woods.
ILEX VOMITORIA Ait. Yaupon. Common along border of bay forest.

CELASTRACEAE

EUONYMUS AMERICANUS L. Strawberry Bush. Infrequent in swamp forest.

ACERACEAE

ACER RUBRUM L. Red Maple. Common in low woods.
ACER RUBRUM var. DRUMMONDII (Hook. & Arn.) Sarg. [A. drummondii Hook & Arn.] Red Maple. Infrequent in low woods.

RHAMNACEAE

BERCHEMIA SCANDENS (Hill) K. Kock. Rattan Vine. Infrequent in swamp forest near stream.
CEANOTHUS AMERICANUS L. New Jersey Tea. Common in dry, open woods.

VITACEAE

AMPELOPSIS ARBOREA (L.) Koehne. Pepper-vine. Common in low woods, roadsides.
PARTHENOCISSUS QUINQUEFOLIA (L.) Planch. Virginia Creeper. Infrequent in mesic woods.
VITIS AESTIVALIS Michx. Summer Grape. Common in shady woodlands.
VITIS ROTUNDIFOLIA Michx. Muscadine. Common in woodlands.
VITIS VULPINA L. Frost Grape. Rare in low woods.

MALVACEAE

HIBISCUS ACULEATUS Walt. Common in dry woods.
HIBISCUS MUTABILIS L. Rarely escaped along roadside. N.
HIBISCUS SYRIACUS L. Rose of Sharon. Rarely escaped or persisting on old home sites. N.
MODIOLA CAROLINIANA (L.) G. Don. Common in cultivated and waste grounds.
SIDA RHOMBIFOLIA L. Common along roadsides and in waste ground. N.

STERCULIACEAE

*FIRMIANA PLATANIFOLIA (L.f.) Marsili. Japanese Varnish Tree. Rare, escaped from cultivation. N.
MELOCHIA CORCHORIFOLIA L. Chocolate-weed. Infrequent in waste places. N.

THEACEAE

GORDONIA LASIANTHUS (L.) Ellis. Loblolly Bay. Rare in bay forest.

HYPERICACEAE

*HYPERICUM BRACHYPHYLLUM (Spach) Steud. [probably corresponds to H. aspalathoides Willd. in Mohr] St. John's Wort. Rare in wet pineland.
**HYPERICUM CANADENSE L. Infrequent on border of lake.
HYPERICUM CISTIFOLIUM Lam. Common along border of lake and low pinelands.
HYPERICUM GALIOIDES Lam. Rare in low pinelands.
HYPERICUM GENTIANOIDES (L.) BSP. Pineweed. Common on roadsides, waste places.
HYPERICUM HYPERICOIDES (L.) Crantz. [Ascyrum hypericoides L.] St. Andrew's Cross. Common in dry woods.
HYPERICUM MUTILUM L. Common in wet, shady areas.
HYPERICUM PSEUDOMACULATUM Bush. [H. maculatum Walt.] Rare in open, sandy woods.
HYPERICUM SETOSUM L. Rare in wet savannah.
HYPERICUM STANS (Michx.) Adams & Robson. [Ascyrum stans Michx.] St. Peter's Wort. Common in dry to mesic woods.
*HYPERICUM STRAGALUM P. Adams and Robson. Infrequent along margins of swamp.
HYPERICUM VIRGINICUM L. [Triadenum virginicum (L.) Raf.] Common in wet, shady areas.

CISTACEAE

HELIANTHEMUM CAROLINIANUM (Walt.) Michx. Frost-weed. Common in dry, open woods.
HELIANTHEMUM GEORGIANUM Chapm. Infrequent in very dry, open areas.
LECHEA MINOR L. Pinweed. Common in dry, open woods, disturbed places.
LECHEA PATULA Leggett. Infrequent in very dry, open areas.
LECHEA VILLOSA Ell. Infrequent in waste places, lawns.

VIOLACEAE

*VIOLA FLORIDANA Brainerd. [probably corresponds to V. papilionacea Pursh and V. palmata L. in Mohr] Violet. Infrequent in woodlands.
VIOLA LANCEOLATA L. Infrequent in wet, sandy areas.
VIOLA PRIMULIFOLIA L. [V. primulaefolia australis Pollard] Common in moist, open areas.
*VIOLA SEPTEMLOBA House. [probably corresponds to V. brittoniana Pollard and V. vicinalis Greene in Mohr] Common in dry, open woods, pinelands.

PASSIFLORACEAE

PASSIFLORA INCARNATA L. Maypop. Infrequent along roadsides and in waste ground.
PASSIFLORA LUTEA L. Yellow Passionflower. Rare along woodland borders.

CACTACEAE

OPUNTIA COMPRESSA (Salisb.) Macbr. [O. humifusa Raf.] Prickly Pear. Rare in dry, open woods.

ELAEAGNACEAE

*ELAEAGNUS UMBELLATA Thunb. Silverberry. Rare in waste places. N.

LYTHRACEAE

*CUPHEA CARTHAGENSIS (Jacq.) Macbr. Waxweed. Infrequent in wet pinelands.
LAGERSTROEMIA INDICA L. Crape-myrtle. Infrequent, escaped on old homesites. N.

MELASTOMATACEAE

RHEXIA ALIFANUS Walt. [R. glabella Michx.] Meadow-beauty. Common in low pinelands.
RHEXIA LUTEA Walt. Infrequent in low pinelands, margins of ponds.
RHEXIA MARIANA L. var. MARIANA. Common in wet meadows, borders of pond, ditches.
*RHEXIA MARIANA L. var. PURPUREA Michx. Occasional in moist open areas.
RHEXIA PETIOLATA Walt. [R. ciliosa Michx.] Rare in wet, open areas.
RHEXIA VIRGINICA L. var. VIRGINICA. Occasional in moist, open areas.
RHEXIA VIRGINICA var. PURSHII (Sprengel) C.W. James. [R. stricta Pursh] Rare in wet, open areas.

ONAGRACEAE

GAURA ANGUSTIFOLIA Michx. Rare on roadsides.
GAURA FILIPES Spach. [G. michauxii Spach.] Common in dry, open woods.
LUDWIGIA ALTERNIFOLIA L. Common along margin of stream and ponds.
*LUDWIGIA BONARIENSIS (Micheli) Hara. Rare along margins of pond.
LUDWIGIA DECURRENS Walt. [Jussiaea decurrens (Walt.) DC.] Common along margin of stream and ponds.
LUDWIGIA GLANDULOSA Walt. Common in wet pinelands, borders of stream and ponds.
LUDWIGIA LEPTOCARPA (Nutt.) H. Hara. [Jussiaea pilosa H.B.K.] Common along stream and pond margins.
LUDWIGIA LINEARIS Walter. Infrequent in moist, open areas.
LUDWIGIA PALUSTRIS (L.) Ell. [Isnardia palustris L.] Infrequent along edge of stream and ponds.
LUDWIGIA PILOSA Walt. Common along stream and pond margins.

LUDWIGIA REPENS Forster. Rare along stream.
OENOTHERA BIENNIS L. [Onagra biennis (L.) Scop.] Evening Primrose. Common on roadsides, waste places.
OENOTHERA FRUTICOSA L. [Kneiffia fruticosa (L.) Raimann] Infrequent in dry, open woods.
OENOTHERA LACINIATA Hill. Common in cultivated and waste places.
OENOTHERA SPECIOSA Nutt. [Xylopleurum speciosum (Nutt.) Raimann] Infrequent on roadsides. N.

HALORAGACEAE

*MYRIOPHYLLUM BRASILIENSE Camb. Parrot-feather. Rare, partly submerged along edge of stream. N.
PROSERPINACA PECTINATA Lam. Infrequent in moist, open areas and ditches.

ARALIACEAE

ARALIA SPINOSA L. Hercules Club. Common in wet open places.

APIACEAE

ANGELICA VENENOSA (Greenway) Fern. Rare in mesic woods.
APIUM LEPTOPHYLLUM (Pers.) F. Muell. [A. anmi (L.) Urban] Marsh Parsley. Infrequent in disturbed places. N.
CENTELLA ASIATICA (L.) Urban. Common in wet, open areas.
CHAEROPHYLLUM TAINTURIERI Hook. Wild Chervil. Infrequent in waste places.
DAUCUS PUSILLUS Michx. Wild Carrot. Rare in waste places.
ERYNGIUM INTEGRIFOLIUM Walt. Infrequent in wet pinelands.
ERYNGIUM YUCCIFOLIUM Michx. var. SYNCHAETUM Michx. Button Snakeroot. Infrequent in dry open woods.
*HYDROCOTYLE BONARIENSIS Lam. [Possibly included by Mohr under H. verticillata] Marsh Pennywort. Common in moist, open areas.
OXYPOLIS RIGIDIOR (L.) Raf. Cowbane. Rare in moist, open areas.
PTILIMNIUM CAPILLACEUM (Michx.) Raf. Common in moist, cultivated grounds and waste places.
SANICULA CANADENSIS L. Sanicle. Rare in mixed deciduous woods.
SPERMOLEPIS DIVARICATA (Walt.) Raf. [S. divaricatus (Walt.) Britton] Rare on roadsides.
SPERMOLEPIS ECHINATA (Nutt. ex DC.) Heller. [S. echinatus (Nutt.) Britton] Infrequent in waste places.
TREPOCARPUS AETHUSAE Nutt. Infrequent along moist, sandy stream banks.

NYSSACEAE

NYSSA BIFLORA Walt. Black Gum. Common in open areas along bay forest.
NYSSA SYLVATICA Marsh. Black Gum. Infrequent in dry, shaded woods.

CORNACEAE

CORNUS FLORIDA L. Flowering Dogwood. Common in woodlands.

CLETHRACEAE

CLETHRA ALNIFOLIA L. var. TOMENTOSA (Lam.) Michx. Sweet Pepperbrush. Common on margins of creek and bay forest.

ERICACEAE

EPIGAEA REPENS L. Trailing Arbutus. Rare in wooded slope along stream.
GAYLUSSACIA DUMOSA (Andr.) T. & G. Dwarf Huckleberry. Common in dry, open woods.
GAYLUSSACIA MOSIERI Small. [G. hirtella (Ait. f.) Klotzsch] Infrequent in sandy border of stream.
GAYLUSSACIA NANA (A. Gray) Small. [Included in G. frondosa tomentosa Gray in Mohr] Infrequent in dry, open woods.
KALMIA LATIFOLIA L. Mountain Laurel. Infrequent in shaded stream banks.
LEUCOTHOE AXILLARIS (Lam.) D. Don. Downy Fetter-bush. Common in bay forest and along stream.

LYONIA LUCIDA (Lam.) K. Koch. [Pieris nitida (Bartr.) Benth. and Hook.] Shining Fetter-bush. Common in wet pinelands and along stream.
MONOTROPA UNIFLORA L. Indian Pipe. Infrequent in sandy pinewoods.
OXYDENDRUM ARBOREUM (L.) DC. Sourwood. Common in wooded slopes along stream.
*RHODODENDRON CANESCENS (Michx.) Sweet. [probably included under Azalea nudiflora L. in Mohr] Wild Azalea. Infrequent in low pinelands.
RHODODENDRON VISCOSUM (L.) Torr. var. SERRULATUM (Small) Ahles. [Azalea viscosa L.] Swamp Honeysuckle, Swamp Azalea. Common on stream margins and in low pineland.
VACCINIUM ARBOREUM Marsh. Sparkleberry. Common in dry, open woods.
*VACCINIUM DARROWII Camp. [probably corresponds to V. myrsinites Lam. in Mohr] Common in dry, open woods and pinelands.
VACCINIUM ELLIOTTII Chapm. Huckleberry. Common in shaded woods along bay forest.
VACCINIUM STAMINEUM L. var. SERICEUM Mohr. Squaw Huckleberry. Common in dry, open woods.
VACCINIUM TENELLUM Ait. Blueberry. Rare in dry, open woods.
VACCINIUM VIRGATUM Ait. Highbush Blueberry. Infrequent along border of bay forest.

PRIMULACEAE

CENTUNCULUS MINIMUS L. Chaffweed. Infrequent in moist, open areas.

EBENACEAE

DIOSPYROS VIRGINIANA L. Persimmon. Common in dry woods.

SYMPLOCACEAE

SYMPLOCOS TINCTORIA (L.) L'Her. Horse-Sugar, Sweetleaf. Common in shaded woods along bay forest.

STYRACACEAE

STYRAX AMERICANA Lam. (S. pulverulenta Michx.] Storax. Rare on stream bank.

OLEACEAE

LIGUSTRUM SINENSE Lour. Privet. Common in low woods, waste places. N.
OSMANTHUS AMERICANA (L.) Gray. Wild Olive. Common in open woods along bay forest.

LOGANIACEAE

CYNOCTONUM MITREOLA (L.) Britton. Miterwort. Rare in wet, open pineland.
CYNOCTONUM SESSILIFOLIUM J.F. Gmel. Infrequent in wet, open pinelands.
GELSEMIUM SEMPERVIRENS (L.) Ait. Yellow Jessamine. Common in dry, open woods.
POLYPREMUM PROCUMBENS L. Common in cultivated and waste grounds.

GENTIANACEAE

GENTIANA VILLOSA L. Gentian. Rare in moist area along swamp.
SABATIA ANGULARIS (L.) Pursh. Rose Pink. Infrequent in wet pinelands.
SABATIA BRACHIATA Ell. [S. angustifolia (Michx.) Britton] Common in dry, open woods.
SABATIA CAMPANULATA (L.) Torrey. Rare in low pinelands.

ASCLEPIADACEAE

ASCLEPIAS AMPLEXICAULIS Smith. [A. obtusifolia Michx.] Milkweed. Infrequent in dry woods, roadsides.
ASCLEPIAS HUMISTRATA Walt. Infrequent in dry open woods.
ASCLEPIAS MICHAUXII Dcne. Common in dry, open woods.
ASCLEPIAS OBOVATA Ell. Infrequent in dry, open woods.
ASCLEPIAS TUBEROSA L. Butterfly-weed. Infrequent in dry, open woods.

**ASCLEPIAS VERTICILLATA L. Rare in dry, open woods.

CONVOLVULACEAE

*BONAMIA PATENS (Desr.) Shinners. Common in dry, sandy woods.
CUSCUTA CAMPESTRIS Yuncker. Dodder. Infrequent parasite in moist areas.
CUSCUTA COMPACTA Juss. Common parasite on woody plants in open, moist areas.
DICHONDRA CAROLINENSIS Michx. [D. evolvulacea (L.f.) Britton] Common in moist lawns and waste places.
JACQUEMONTIA TAMNIFOLIA (L.) Griseb. Infrequent in open waste places, roadsides. N.
**IPOMOEA COCCINEA L. Red Morning-glory. Rare in waste places. N.
IPOMOEA HEDERACEA (L.) Jacq. Morning-glory. Common in dry, open woods and waste places.
IPOMOEA LACUNOSA L. Rare in dry, open woods and waste places.
IPOMOEA PANDURATA (L.) G.F.W. Mey. Man-root. Common in dry, open woods and waste places.
IPOMOEA PURPUREA (L.) Roth. Common Morning-glory. Infrequent in waste places. N.
IPOMOEA QUAMOCLIT L. Cypress Vine. Infrequent in cultivated and waste places. N.
IPOMOEA TRICHOCARPA Ell. [I. carolina (L.) Pursh] Infrequent in dry, sandy areas.

POLEMONIACEAE

PHLOX PILOSA L. [Including P. pilosa detonsa Gray in Mohr] Common in dry, open woods and pinelands.

BORAGINACEAE

ONOSMODIUM VIRGINIANUM (L.) A. DC. False-Gromwell. Common in dry, sandy open woods.

VERBENACEAE

CALLICARPA AMERICANA L. French Mulberry. Common in open woods, thickets.
LANTANA CAMARA L. Rare in waste places. N.
LIPPIA NODIFLORA (L.) Michx. Common in moist, open sandy places, lawns.
*VERBENA BRASILIENSIS Velloso. Common in waste places, roadsides. N.
VERBENA CARNEA Medicus. [V. carolina L.] Common in dry, open woods.
VERBENA OFFICINALIS L. Rare on roadsides, N.
VERBENA RIGIDA Spreng. Infrequent on roadsides, waste places. N.
*VERBENA TENUISECTA Briq. Rare in dry, open woods. N.

LAMIACEAE

CALAMINTHA COCCINEA (Nutt.) Benth. in DC. [Clinopodium coccineum (Nutt.) Kuntze] Common in dry, open woods.
DRACOCEPHALUM VIRGINIANUM L. [Physostegia virginiana (L.) Benth.] Obedient Plant. Rare in ditches, roadsides.
*HEDEOMA HISPIDUM Pursh. Infrequent along dry roadside.
HYPTIS ALATA (Raf.) Shinners. [Mesosphaerum rugosum (L.) Pollard] Common in low woods.
*HYPTIS MUTABILIS (A. Richard) Briq. Rare along moist shady roadside. N.
LAMIUM AMPLEXICAULE L. Henbit. Common on roadsides, lawn, waste places. N.
LYCOPUS RUBELLUS Moench. Common along margins of swamp forest.
**LYCOPUS VIRGINICUS L. Rare along margin of swamp forest.
MONARDA PUNCTATA L. Infrequent in dry, open woods, roadsides.
PERILLA FRUTESCENS (L.) Britt. Infrequent along shaded, disturbed stream banks.
PYCNANTHEMUM INCANUM (L.) Michx. [Koellia albescens (Torr. & Gray) Kuntze.] Common in dry, open woods.
SALVIA AZUREA Lam. Sage. Common in dry, open woods.
SALVIA LYRATA L. Common in cultivated and waste grounds.
SCUTELLARIA ELLIPTICA Muhl. [S. pilosa Michx.] Skullcap. Common in dry, open woods.
SCUTELLARIA INTEGRIFOLIA L. Infrequent along border of pond.

*STACHYS FLORIDANA Shuttlew. Locally known as Rattlesnake Weed. Common in cultivated and waste grounds and along stream banks.
TRICHOSTEMA DICHOTOMUM L. Blue Curls. Common in dry, open woods.
TRICHOSTEMA SETACEUM Houtt. [T. lineare Nutt.] Infrequent in dry, open woods, roadsides.

SOLANACEAE

DATURA STRAMONIUM L. Jimson Weed. Rare in disturbed habitats. N.
PHYSALIS ANGULATA L. Ground Cherry. Rare on waste grounds. N.
PHYSALIS PUBESCENS L. [P. barbadensis Jacq.] Uncommon weed in campus lawn.
PHYSALIS VISCOSA L. Infrequent on dry, sandy roadsides.
SOLANUM AMERICANUM Mill. Nightshade. Infrequent in waste places.
SOLANUM CAROLINENSE L. Common on roadsides, waste places.
SOLANUM SISYMBRIIFOLIUM Lam. Rare in waste places. N.

SCROPHULARIACEAE

AGALINIS FASCICULATA (Ell.) Raf. [Gerardia fasciculata Ell.] Infrequent in dry, open woods.
*AGALINIS OBTUSIFOLIA Raf. Rare in dry, open woods.
AGALINIS PURPUREA (L.) Pennell. [Gerardia purpurea L.] Common in dry, open woods.
AGALINIS SETACEA (J.F. Gmel) Raf. Common in dry, open woods.
**AUREOLARIA FLAVA (L.) Farwell. [Dasystoma flava (L.) Wood] Infrequent in dry, open woods.
AUREOLARIA PECTINATA (Nutt.) Pennell. [Dasystoma pectinata (Nutt.) Benth.] Common in dry, open woods.
*BUCHNERA FLORIDANA Gandoger. [Very close to B. americana and B. elongata Sw. in Mohr] Infrequent in moist savannahs.
GRATIOLA PILOSA Michx. Hedge Hyssop. Infrequent in moist open areas along stream and ponds.
GRATIOLA VIRGINIANA L. [G. sphaerocarpa Ell.] Infrequent in moist, open areas.
LINARIA CANADENSIS (L.) Dumont. Blue Toad-flax. Common on roadsides, weedy places, lawns.
LINDERNIA DUBIA (L.) Pennell. [Ilysanthes gratioloides (L.) Benth.] Rare in wet, muddy margins of stream.
*MAZUS JAPONICUS (Thunberg) Kuntze. Rare in moist lawns. N.
MECARDONIA ACUMINATA (Walt.) Small. [Monniera acuminata (Walt.) Kuntze] Common in wet, open areas near stream.
MICRANTHEMUM UMBROSUM (J.F. Gmel.) Blake. [M. orbiculatum Michx.] Infrequent in wet, sandy open areas.
PEDICULARIS CANADENSIS L. Lousewort, Wood Betony. Rare in shaded pinelands near swamp forest.
*PENSTEMON AUSTRALIS Small. [Probably corresponds at least partly to P. hirsutus (L.) Willd. in Mohr.] Beard-tongue. Common in dry, open woods.
*SCOPARIA DULCIS L. Sweet-broom, Goat Weed. Rare in cultivated grounds. N.
VERBASCUM THAPSUS L. Wooly Mullein. Rare in waste places. N.
VERONICA ARVENSIS L. Corn Speedwell. Common in cultivated and waste grounds. N.
VERONICA PEREGRINA L. Infrequent in cultivated and waste grounds.

BIGNONIACEAE

ANISOSTICHUS CAPREOLATA (L.) Bureau. [Bignonia crucigera L.] Cross Vine. Common along margins of swamp forest.
CAMPSIS RADICANS (L.) Seem. [Tecoma radicans L.] Trumpet Vine. Infrequent in disturbed, shady areas.
CATALPA BIGNONIOIDES Walt. [C. catalpa (L.) Karst.] Infrequent in low, disturbed woodlands.

OROBANCHACEAE

**OROBANCHE UNIFLORA L. Cancer-root. Rare in moist, sandy, open area near stream.

LENTIBULARIACEAE

PINGUICULA PLANIFOLIA Chapman. Butterwort. Rare in low pinelands.
PINGUICULA LUTEA Walt. Infrequent in low pinelands.
UTRICULARIA BIFLORA Lam. Bladderwort. Infrequent in shallow margins of ponds.
UTRICULARIA JUNCEA Vahl. Infrequent in shallow margins of ponds.
UTRICULARIA SUBULATA L. Common in wet pinelands.

ACANTHACEAE

RUELLIA CILIOSA Pursh. Common in dry, open woods.

PLANTAGINACEAE

PLANTAGO ARISTATA Michx. Plantain. Infrequent in dry, sandy roadsides, railroad ballast. N.
PLANTAGO HETEROPHYLLA Nutt. Common on roadsides, cultivated and waste grounds.
*PLANTAGO HOOKERIANA Fisch. & Mey. var. NUDA (Gray) Poe. Infrequent on railroad ballast. N.
PLANTAGO LANCEOLATA L. Infrequent in waste grounds. N.
PLANTAGO MAJOR L. Rare lawn weed.
PLANTAGO VIRGINICA L. Common in cultivated and waste grounds.

RUBIACEAE

CEPHALANTHUS OCCIDENTALIS L. Button Bush. Infrequent in low areas, margins of creek and ponds.
DIODIA TERES Walt. Common in dry roadsides, waste places, open woods.
DIODIA VIRGINIANA L. Common in moist, cultivated ground and swamp forest margins.
GALIUM APARINE L. Bedstraw. Infrequent in moist roadsides and waste places.
GALIUM HISPIDULUM Michx. Common in dry, open woods.
GALIUM PILOSUM Ait. Common in dry, open woods, roadsides.
GALIUM TINCTORIUM L. Infrequent along margins of pond.
HOUSTONIA PROCUMBENS (J.F. Gmel) Standley. [H. rotundifolia Michx.] Common in sandy pinelands.
HOUSTONIA PUSILLA Schoepf. [H. minor (Michx.) Britton] Infrequent in cultivated and waste grounds.
MITCHELLA REPENS L. Partridge Berry. Infrequent in mesic woods.
OLDENLANDIA BOSCII (DC) Chapman. Infrequent along border of ponds and streams.
*OLDENLANDIA CORYMBOSA L. Rare in waste places.
OLDENLANDIA FASCICULATA (Bertol.) Small. [O. littoralis Mohr] Infrequent in moist, open areas.
OLDENLANDIA UNIFLORA L. Infrequent in moist, open areas.
*RICHARDIA BRASILIENSIS (Moq.) Gomez. Rare on roadsides. N.
RICHARDIA SCABRA L. Common in cultivated and waste grounds. N.
*SHERARDIA ARVENSIS L. Infrequent in cultivated grounds. N.

CAPRIFOLIACEAE

LONICERA JAPONICA Thunb. Japanese Honeysuckle. Common in cultivated and waste grounds, woodlands. N.
LONICERA SEMPERVIRENS L. Coral Honeysuckle. Rare in pinelands.
SAMBUCUS CANADENSIS L. Elderberry. Infrequent in open disturbed areas along stream.
VIBURNUM NUDUM L. Possum-Haw Viburnum. Common in bay forest and along stream banks.

VALERIANACEAE

VALERIANELLA RADIATA (L.) Dufr. Corn Salad. Infrequent in moist, open waste places.

CUCURBITACEAE

MELOTHRIA PENDULA L. Creeping Cucumber. Infrequent in moist cultivated grounds.

CAMPANULACEAE

*LOBELIA GEORGIANA McVaugh. Lobelia. Infrequent in low pinelands.

LOBELIA GLANDULOSA Walt. [Possibly corresponds to L. Paludosa Nutt. in Mohr] Infrequent in moist pinelands.

LOBELIA PUBERULA Michx. Common in dry to moist open woods.

SPECULARIA BIFLORA (R. & P.) Fisch. & Mey. [Legouzia biflora (Ruiz & Pav.) Britton] Venus' Looking-glass. Common in cultivated and waste grounds.

SPECULARIA PERFOLIATA (L.) A.DC. [Legouzia perfoliata (L.) Britton] Common in cultivated and waste grounds.

*WAHLENBERGIA MARGINATA (Thunb.) DC. Infrequent in cultivated and waste grounds. N.

ASTERACEAE

ACHILLLEA MILLEFOLIUM L. Yarrow. Rare in waste places. N.

AGERATINA AROMATICA (L.) K. & R. [Eupatorium aromaticum L.] Common in dry open woods.

AMBROSIA ARTEMISIIFOLIA L. Ragweed. Common on roadsides, waste places.

AMBROSIA TRIFIDA L. Giant Ragweed. Common on roadsides, waste places.

ASTER ADNATUS Nurr. Aster. Common in dry, open woods.

ASTER BIFOLIATUS (Walt.) Ahles. [Sericocarpus bifoliatus (Walt.) Porter] Common in dry, open woods.

ASTER CONCOLOR L. Common in dry, open woods.

ASTER DUMOSUS L. Common in dry, open sites.

ASTER EXILIS Ell. Infrequent in moist, open sites.

ASTER LINARIIFOLIUS L. [Ionactis linariifolius (L.) Greene] Common in dry, open woods.

ASTER PATENS Ait. var. GRACILIS Hook. Common in woodland borders.

ASTER PILOSUS Willd. [A. ericoides pilosus (Willd.) Porter] Frost Aster. Rare in woodland borders.

ASTER SOLIDAGINEUS Michx. [Sericocarpus linifolius (L.) B.S.P.] White Topped Aster. Infrequent in dry woodlands.

ASTER UMBELLATUS Mill. var. BREVISQUAMUS Fern. [Doellingeria humilis (Willd.) Britton] Rare along margin of swamp forest.

BACCHARIS HALIMIFOLIA L. Groundsel Tree, Sea Myrtle. Infrequent in wet, open areas.

BALDUINA UNIFLORA Nutt. [Actinospermum uniflorum (Nutt.) Barnhart] Common in moist savannahs.

BIDENS BIPINNATA L. Spanish Needles. Infrequent in moist open areas.

BIDENS FRONDOSA L. Begger-ticks. Common in wet open areas.

BIDENS MITIS (Michx.) Sherff. [Very close to B. Coronata (L.) Fisch. in Mohr] Common in wet open area.

BIGELOWIA NUDATA (Michx.) DC. [Chondrophora nudata (Michx.) Britton] Rayless Goldenrod. Infrequent in open moist areas.

BRINTONIA DISCOIDEA (Ell.) Greene. Infrequent along margin of swamp forest.

*CALYPTOCARPUS VIALIS Less. Rare in waste place.

CARDUUS SPINOSISSIMUS Walt. Thistle. Infrequent on roadsides, waste places.

CHAPTALIA TOMENTOSA Vent. [Thyrsanthema semifloscularе (Walt.) Kuntze] Sun-bonnets. Common in open, marshy area.

CONOCLINIUM COELESTINUM (L.) DC. [Eupatorium coelestinum L.] Mist Flower. Common in moist open areas, ditches.

COREOPSIS BASALIS (Dietr.) Blake. [C. drummondii (D.Don) Torr. and Gray] Rare in vacant lot. N.

COREOPSIS MAJOR Walt. Common in dry, open woods.

COREOPSIS TINCTORIA Nutt. Infrequent along roadsides. N.

*CREPIS JAPONICA (L.) Benth. Hawk's beard. Infrequent in disturbed habitats, flower beds. N.

CROPTILON DIVARICATUM (Nutt.) Raf. [Isoppapus divaricatus (Nutt.) Torr. and Gray] Common on roadsides, waste places.

ECLIPTA ALBA (L.) Hassk. Rare on stream bank.

*ELEPHANTOPUS ELATUS Bertoloni. Common in dry, open woods.

**ELEPHANTOPUS NUDATUS Gray. Common in dry, open woods.
ELEPHANTOPUS TOMENTOSUS L. Infrequent in dry woods.
ERECHTITES HIERACIFOLIA (L.) Raf. Fireweed. Infrequent in moist, disturbed sites.
ERIGERON BONARIENSIS L. Common on roadsides, waste places.
ERIGERON CANADENSIS L. Horseweed. Common on roadsides, waste places.
ERIGERON PHILADELPHICUS L. Daisy Fleabane. Common on waste ground.
ERIGERON STRIGOSUS Muhl. ex Willd. [E. ramosus (Walt.) B.S.P.] Common on roadsides, waste places.
ERIGERON VERNUS (L.) T. & G. Infrequent in moist, open areas.
EUPATORIUM ALBUM L. Thoroughwort. Common in dry, open woods.
EUPATORIUM CAPILLIFOLIUM (Lam.) Small var. CAPILLIFOLIUM. Dog Fennel. Common in roadsides, disturbed areas.
EUPATORIUM CAPILLIFOLIUM var. LEPTOPHYLLUM (DC.) Ahles. Infrequent on roadsides.
EUPATORIUM COMPOSITIFOLIUM Walt. Rough Dog Fennel. Common on roadsides, waste places.
EUPATORIUM CUNEIFOLIUM Willd. [E. linearifolium Walt. and E. tortifolium Chapm.] Common in dry open woods, waste places.
EUPATORIUM FISTULOSUM Barratt. [E. maculatum L.] Joe-Pye Weed. Infrequent along margin of swamp forest.
EUPATORIUM PERFOLIATUM L. Boneset. Infrequent along margin of swamp forest.
*EUPATORIUM RECURVANS Small. Thoroughwort. Infrequent in dry woodlands.
EUPATORIUM ROTUNDIFOLIUM L. Common in dry woodlands.
EUPATORIUM SEMISERRATUM DC. Infrequent in moist woodlands.
*FACELIS RETUSA (Lam.) Sch.-Bip. Common in dry sandy roadsides, lawns. N.
GAILLARDIA AESTIVALIS (Walt.) Rock. var. LANCEOLATA (Michx.) Ahles. [G. lanceolata Michx.] Common in dry, open woods.
GNAPHALIUM OBTUSIFOLIUM L. Rabbit Tobacco. Common in cultivated and waste grounds.
GNAPHALIUM PURPUREUM L. Cudweed. Common in cultivated and waste grounds.
GNAPHALIUM PURPUREUM var. SPATHULATUM (Lam.) Ahles. [G. spatulathum Lam.] Common in cultivated and waste grounds.
HELENIUM AMARUM (Raf.) H. Rock. [H. tenuifolium Nutt.] Bitter-weed. Common on roadsides, waste places.
HELENIUM FLEXUOSUM Raf. [H. nudiflorum Nutt.] Sneeze-weed. Rare in moist, open area.
*HELIANTHUS ANNUUS L. Sunflower. Rare in waste places. N.
HELIANTHUS ANGUSTIFOLIUS L. Common in wet savannahs.
HELIANTHUS HETEROPHYLLUS Nutt. Infrequent along moist, open stream banks.
HELIANTHUS RADULA (Pursh) T. & G. Common in dry, open woods.
HETEROTHECA GRAMINIFOLIA (Michx.) Shinners. [Chrysopsis graminifolia (Michx.) Nutt.] Golden Aster. Common in dry, open woods.
HETEROTHECA MARIANA (L.) Shinners. [Chrysopsis mariana (L.) Nutt.] Common in dry woods.
HETEROTHECA TRICHOPHYLLA (Nutt.) Shinners. [Chrysopsis trichophylla Nutt.] Infrequent in dry woods.
HIERACIUM GRONOVII L. Hawkweed. Infrequent in dry woods.
*HYPOCHAERIS ELATA (Wedd.) Griseb. Infrequent lawn weed, roadside.
*HYPOCHAERIS RADICATA L. Rare lawn weed.
IVA ANNUA L. [I. ciliata Willd.] Rare along roadside.
KRIGIA OPPOSITIFOLIA Raf. [Serinea oppositifolia (Raf.) Kuntze] Dwarf Dandelion. Common on roadsides, cultivated grounds.
KRIGIA VIRGINICA (L.) Willd. [Adopogon carolinianum (Walt.) Britton] Common on roadsides, cultivated grounds.
KUHNIA MOSIERI Small. [K. kuhnia (Gaert.) Mohr] False Boneset. Rare in dry pine-woods.
LACTUCA CANADENSIS L. [L. sagittifolia Ell.] Wild Lettuce. Common on roadsides, waste places.
LACTUCA FLORIDANA (L) Gaertn. Infrequent along disturbed stream banks.

LIATRIS ELEGANS (Walt.) Michx. [Lacinaria elegans (Walt.) Kuntze] Blazing Star. Common in dry, open woods.

LIATRIS GRACILIS Pursh. [Lacinaria gracilis Pursh] Infrequent in dry, open woodlands.

LIATRIS GRAMINIFOLIA Willd. [Lacinaria graminifolia pilosa (Ait.) Britton] Common in dry, open woods.

LIATRIS SPICATA (L.) Willd. [Lacinaria spicata (L.) Kuntze] Rare in dry, open site.

LIATRIS SQUARROSA (L.) Michx. [Lacinaria squarrosa (L.) Hill] Infrequent in dry, open woods.

MIKANIA SCANDENS (L.) Willd. [Willughbaeya scandens (L.) Kuntze] Climbing Boneset. Common in moist open areas.

PARTHENIUM HYSTEROPHORUS L. Rare in cultivated and waste grounds. N.

PLUCHEA CAMPHORATA (L.) DC. Marsh-fleabane. Common along margin of creek and ponds and in wet savannah.

PLUCHEA FOETIDA (L.) DC. Common along margin of creek and ponds.

PRENANTHES SERPENTARIA Pursh. [Nabalus serpentaria (Pursh) Hook.] Gall-of-the-earth. Infrequent in dry woodlands.

PYRRHOPAPPUS CAROLINIANUS (Walt.) DC. [Sitilias caroliniana (Walt.) Raf.] False Dandelion. Common on roadsides, lawns, waste places.

RUDBECKIA HIRTA L. Black-eyed Susan. Common in dry, open woods, waste places.

SENECIO GLABELLUS Poir. [S. lobatus Pers.] Butterweed. Rare in moist, cultivated grounds.

**SILPHIUM DENTATUM Ell. var. GATESII (Mohr) Ahles. [S. gatesii Mohr] Infrequent along margin of swamp forest.

SOLIDAGO ALTISSIMA L. [S. canadensis L.] Goldenrod. Common on roadsides, waste places.

SOLIDAGO FISTULOSA Mill. Rare in moist pinelands.

SOLIDAGO GRAMINIFOLIA (L.) Salisb. Rare in moist, open areas.

*SOLIDAGO MICROCEPHALA (Greene) Bush. [Possibly corresponds to Euthammia caroliniana (L.) Greene in Mohr] Common in wet, open areas.

SOLIDAGO ODORA Ait. Common in dry, open woods.

SOLIDAGO PATULA Muhl. ex Willd. var. STRICTULA T. & G. [S. salicina Ell.] Rare in moist, open area.

SOLIDAGO PUBERULA Nutt. var. PULVERULENTA (Nutt.) Chapm. Infrequent in dry, open woods.

SOLIDAGO RUGOSA Mill. Infrequent in dry woods, roadsides.

*SOLIDAGO RUGOSA var. CELTIDIFOLIA (Small) Fern. Infrequent in moist areas near stream.

SOLIDAGO STRICTA Ait. Infrequent in moist pinelands.

*SOLIDAGO TORTIFOLIA Ell. Infrequent in dry, open woods.

SOLIVA PTEROSPERMA (Juss.) Less. Infrequent in moist lawns. N.

SONCHUS ASPER (L.) Sow-thistle. Common on roadsides, waste places. N.

SONCHUS OLERACEUS L. Common on roadsides, waste places. N.

SPILANTHES AMERICANA (Mutis) Hieron. var. REPENS (Walt.) A.H. Moore [S. repens (Walt.) Michx.] Rare on stream banks.

TARAXACUM OFFICINALE Wiggers [T. taraxacum (L.) Karst] Dandelion. Infrequent on lawns. N.

TETRAGONOTHECA HELIANTHOIDES L. Common in dry, open woods.

TRILISA ODORATISSIMA (J.G. Gmel.) Cass. Deer's Tongue. Common in dry, open woods and moist pinelands.

VERBESINA OCCIDENTALIS (L.) Walt. Crownbeard, Wingstem. Common on roadsides, woodland borders.

VERBESINA VIRGINICA L. Rare in dry, open woods.

VERNONIA ALTISSIMA Nutt. [V. gigantea (Walt.) Britton] Ironweed. Infrequent on border of swamp forest.

VERNONIA ANGUSTIFOLIA Michx. [V. graminifolia Walt.] Common in dry, open woods.

XANTHIUM STRUMARIUM L. var. GLABRATUM (DC.) Cronquist. Cocklebur. Infrequent along open stream banks.

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SYNOPSIS OF *SUAEDA* (CHENOPODIACEAE) IN NORTH AMERICA

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ABSTRACT

The study of North American specimens of the halophytic genus *Suaeda* has led to recognition of 14 species and five varieties, plus two species of doubtful status. Taxonomic problems associated with the succulent habit of *Suaeda* and the historical development of the genus are discussed. Distribution, typification and systematics of the species are presented with citation of specimens from each county or district recorded.

Suaeda, a chenopodiaceous genus of sea coasts and inland saline soils, has long been a source of confusion to taxonomists and generally ignored by collectors. It is a relatively unattractive plant and species' characteristics are not easily noted without magnification. Dried specimens do not always show the same leaf and calyx features as fresh, succulent plants, and leaf shape in cross section varies with the degree of salinity of the habitat.

The plants seem to exhibit phenotypic plasticity which has not previously been taken into account by taxonomists in treatments of *Suaeda*. Succulence and roundness of the leaf in cross section increases with increasing salinity of habitat. In his study on halophytes Ungar (1974) found that even the habit of *Suaeda*, particularly *S. depressa* and *S. maritima*, varies according to the salinity of the soil. He reported that in highly saline soils *S. depressa* will be dwarfed with a prostrate growth form, or appear as a weak, single-stemmed upright plant; both forms under 20 cm. long. In conditions of lower salt concentration the plants exhibit a more robust growth form. A single main shoot or several strong shoots 30 to 100 cm. long may be produced. We observed similar habit differences for *S. depressa* around alkaline lake beds in northern California and south central Oregon.

There is also some question about the effects of heat and moisture on the degree of pubescence. Observations made by Henrickson (personal communication) of the very pubescent shrub *S. suffrutescens* in northern Mexico seem to indicate that the plants are pubescent in very dry years and glabrous or nearly so in wetter years. The phenotypic expression in relation to habitat conditions needs further investigation, perhaps before a world-wide monograph on *Suaeda* can be attempted.

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Characters that are constant, and presumably reliable at the species level, appear to be: herbaceous versus suffrutescent habit, inflorescence types (including density of glomerules), leaf shape and internode length, calyx features and seed size. There are five basic calyx types noted in North American specimens (sepals thin and rounded; sepals thickened and hooded at the apex; sepals sharply horned [corniculate] and hooded at the apex; sepals hooded at apex and inflated vertically or keeled [carinate]; sepals hooded at apex, or corniculate, and inflated vertically as well as basally [forming both a keel and transverse wing]).

It must be kept in mind that these plants are very succulent, so that the calyx and leaves will flatten or shrivel upon drying. Our examination of fresh and dry specimens has shown that the basic calyx remains constant. The following glossary to sepal characters and Figure 1 may be helpful in interpreting terminology related to calyx types employed in the key and descriptions.

Carinate: keeled, with a vertical ridge or dorsal inflation from base to apex

Corniculate: horned, pointed, with one or more projecting dorsal appendages; may be furrowed or folded upon drying

Crispate: undulating or very wavy dried keel

Cucullate: hooded, rounded at the apex over the seed, usually thickened and not horned nor keeled

Inflated lobe: dorsal thickening of sepal or swelling to form a vertical ridge, basal swelling or tubercle-like projection

Rounded: not inflated dorsally nor greatly thickened at apex, usually a thin sepal closely fitting over seed

Transverse wing: flattened horizontal projection, usually circumbasal and irregular; a dry, basally inflated lobe.

Suaeda might be confused with other genera of Chenopodiaceae and the following comparisons may help differentiating among them:

Suaeda: flat, spiral embryo; endosperm scant or lacking; pubescence short or absent; leaves simple, linear; usually with three scarious floral bracts; fruiting calyx rounded, cucullate, corniculate, or may be transversely winged at base

Halogeton: spiral embryo; endosperm scant or lacking; pubescence pilose, especially in inflorescence; leaves linear, tipped with a short conical tubercle prolonged to a bristle; flowers bracteolate; fruiting calyx horizontally winged near the apex

Kochia: annular embryo; endosperm present; pubescence simple, villous to tomentose in inflorescence; leaves simple, linear; no scarious bracts present; fruiting calyx rounded, enclosing fruit, becoming carinate to winged horizontally toward the base, cleft no more than halfway to base

Bassia: annular embryo, endosperm present; pubescence pilose or tomentose, especially in inflorescence; leaves linear to lanceolate; bracts one to two, greenish; fruiting calyx cleft more than halfway to base, armed with a short and blunt to elongated and hooked spine from the back of each lobe.

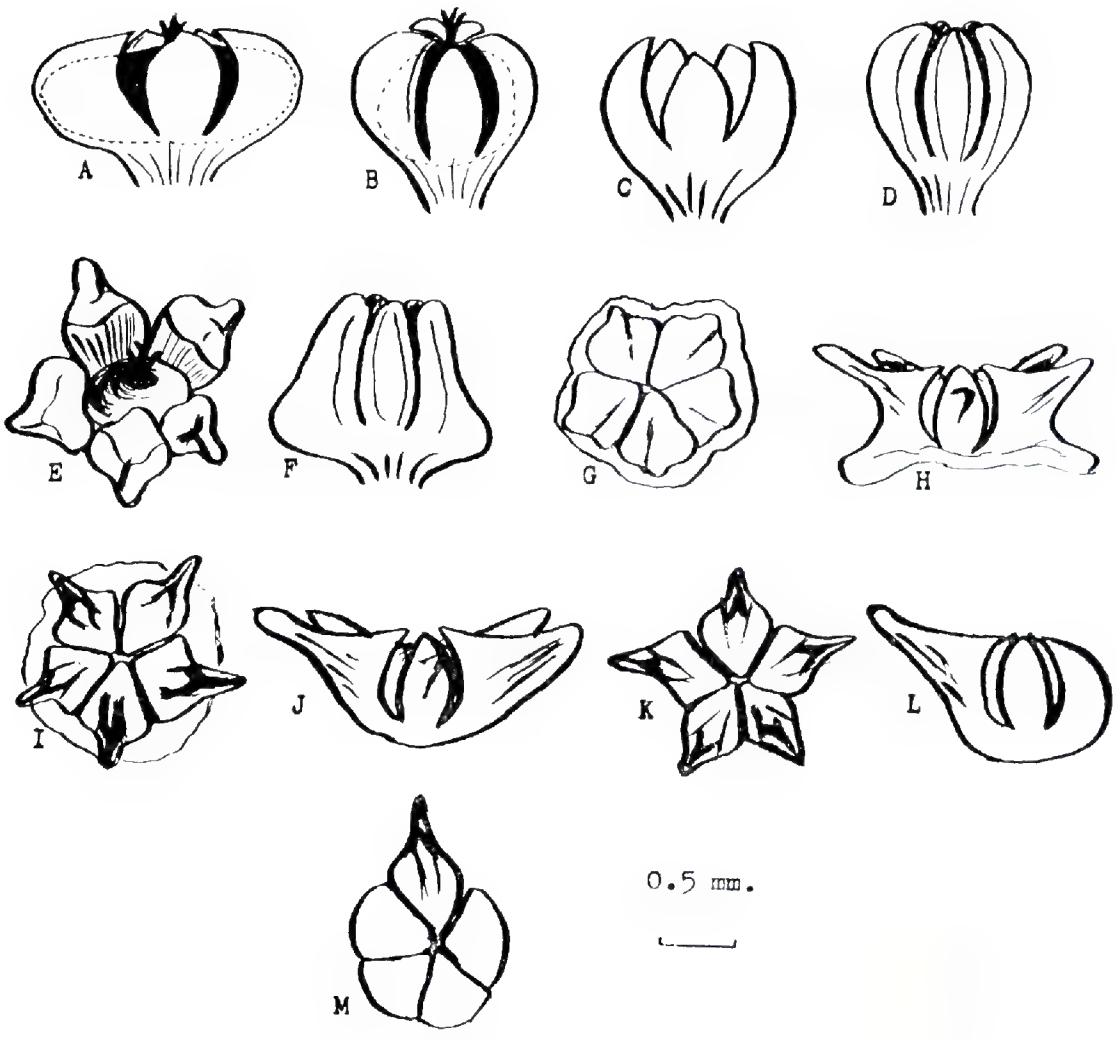

Figure 1. Calyx types of *Suaeda* in North America.

I. Sepals thin, rounded, not inflated, as *S. maritima* (A).

II. Sepals thickened at apex, hooded (cucullate), as *S. torreyana* (B—fresh, C—dried, mature).

III. Sepals inflated vertically, keeled (carinate) as *S. linearis* (D—fresh, E—dried, mature).

IV. Sepals inflated vertically as well as obliquely to the base, forming a keel and a transverse wing upon drying, as *S. jacoensis* and *S. mexicana* (F, G), and *S. occidentalis*, which is corniculate and winged (H, I).

V. Sepals appendaged dorsally with horn-like projections (corniculate), as *S. depressa* (J, K), and *S. americana* (L, M).

Historically, species that were eventually named *Suaeda* were segregated from the Linnaean (1753) genera *Chenopodium* and *Salsola* by Meyer (1829), who included them in his new genus *Schoberia*. Moquin-Tandon (1840), in his *Chenopodearum Monographica Enumeratio*, divided Chenopodiaceae into two "suborders" and created six more synonyms for *Suaeda* based upon such relatively inconstant characters as seed vertical or seed horizontal.

In 1896 Druce published the names *Dondia fruticosa* (Forsk.) and *D. maritima* (Dum.), transferring them from *Suaeda* to revitalize *Dondia* Adanson 1763. The use of *Dondia* was retained by Heller in 1898 and 1910 with his transfer of ten more species from *Suaeda*, and the name was also used by Standley in his publication on Chenopodiales in *North American Flora* (1916). In 1918 Macbride transferred *Dondia* back to *Suaeda*, and was followed by Standley in 1929 and 1930.

In 1954 action by the International Botanical Congress conserved *Suaeda* against *Dondia* and also against *Lerchea* Rueling 1774; the latter an illegitimate orthographical variant of *Lerchia* A. Haller ex Zinn 1757, which was also unavailable because of *Lerchea* Linnaeus 1771 *nom. cons.* *Dondia* was a superfluous name for *Lerchia*, so was also illegitimate. This congress conserved *Suaeda*, based on Forskal, but did not provide a generic description. To avoid conserving a *nomen nudum*, Brenan (1954) proposed the solution by amending the name and citing the first valid publication for *Suaeda*, which is Scopoli (1777). As finally accepted and published by Ricketts and Stafleu (1960) the citation for *Suaeda* is: *Suaeda* (Forskal, Fl. Aegypt. Arab. 69 t. 181. 1775) ex Scopoli, Intr. 333. 1777, excl. verba falsa "Capsula quinquevalvis . . . polysperma." The type species is *S. vera* Forskal ex J. F. Gmelin (1791).

The first revision of North American Chenopodiaceae was published by Sereno Watson in 1874. He delimited seven species of *Suaeda*, amending and adding to his 1871 publication, which was based upon specimens collected on the geological exploration of the 40th parallel under Clarence King. Watson brought together the American-occurring species, which had previously been placed under genera as *Salsola*, *Chenopodium*, *Schoberia*, and *Chenopodina*. John Torrey (1828, 1843, 1853, 1857) was one of the first American botanists to examine plants collected from western America. He apparently found plants of *Suaeda* which did not exactly fit the existing species' descriptions. Watson resolved the problem somewhat by describing new species of *Suaeda*, including *S. depressa*, *S. torreyana*, *S. diffusa*, *S. suffrutescens*, *S. californica*, and *S. occidentalis*. He also named *S. linearis* var. *ramosa* of northeastern America.

In 1907 M. L. Fernald published a work on northeastern American *Suaeda*, including *S. maritima*, *S. linearis* var. *ramosa*, and two new species, *S. richii*, and *S. americana*.

Major changes in the taxonomy of the genus occurred in 1916 with Paul C. Standley's work on Chenopodiales. He recognized 20 species of *Dondia*,

including *D. minutiflora*, named by Watson in 1883 (as a species of *Suaeda*), *D. insularis* Britton (1906), and eight new species that he named: *D. nigra*, *D. fernaldii*, *D. mexicana*, *D. ramosissima*, *D. palmeri*, *D. taxifolia*, *D. tampicensis*, and *D. brevifolia*.

Three new species and two varieties from Texas and Mexico were added in 1943 by I. M. Johnston: *S. jacoensis*, *S. nigrescens*, *S. nigrescens* var. *glabra*, *S. suffrutescens* var. *detonsa*, and *S. duripes*. Recent floristic works (e.g. Correll and Johnston [1970], Fernald [1952], Gleason [1952], Hitchcock et al. [1969], Lundell [1969], and Munz [1974]) have included the above species, with some lowered to the varietal level or included in synonymy.

Trends in morphology and distribution of the more than 100 species of *Suaeda* were examined on a world-wide basis by Iljin (1936) who believed the genus to have originated not later than by the beginning of the Cretaceous period. Iljin published a map of the range of *Suaeda* showing the cosmopolitan nature of its distribution, plus a discussion of his seven sections based upon stigma types. Three of those sections (Platystigma, Heterosperma, and Limbogermen) can be distinguished among North American species of *Suaeda*.

The present treatment is based upon our examination of North American specimens of *Suaeda* from the following herbaria: A, CSULA, DAV, F, GH, MO, MU, NY, OSU, TEX, UC, UC-JEP, US, and UT. Several Old World specimens were also examined from F, GH, MO, NY, and US. Curators of these herbaria are gratefully acknowledged for loans of specimens. We are also deeply appreciative of the loan of specimens, slides, and information on personal observations receive from Dr. James Henrickson of California State University at Los Angeles. Personal collections from northern California and southern Oregon are deposited at MU.

Following the species description is a citation of one specimen per county or district recorded which displays mature floral and vegetative characteristics. Measurements and other data given in the descriptions and key are based primarily upon dried specimens. Unless otherwise noted, all type specimens seen are indicated.

GENERIC DESCRIPTION

Annual or perennial herbs, or suffrutescent perennials, more or less fleshy, glabrous to short pubescent; leaves alternate, narrow and often terete, never spine-tipped; flowers bisexual or unisexual (the plants sometimes monoecious or polygamous), sessile, in clusters of (1-) 3 (-9) in the upper axils; bracts usually 3, scarious; calyx 5-cleft more than halfway to the base, the lobes narrow, keeled (carinate), transversely winged, or rounded on the back, sometimes thickly hooded (cucullate) at the apex, or horned (corniculate); stamens 5, the short filaments usually exserted at maturity; ovary subglobose or depressed, one-celled, the ovule solitary, basal, the styles (2-) 3; utricle enclosed by the infolding sepals, pericarp usually free from seed; seed horizontal or vertical; endosperm scanty or none; embryo coiled in a flat spiral.

SPECIES OF *SUAEDA* IN NORTH AMERICA

A. Glabrous herbaceous annuals or perennials; mature sepals thin, rounded and sometimes inflated vertically and basally; if inflated, sepals may dry with sharply pointed apical horns (corniculate), rounded hoods, vertical keels and/or transverse wings at the base.

B. One or all sepals sharply pointed or corniculate, sometimes with transverse wing development.

C. One or two sepals sharply pointed; along north Atlantic Coast. 1. *S. americana*

C. All sepals sharply pointed and/or transversely winged; interior western U.S.

D. Sepals transversely winged and corniculate; leaves narrow at base; flowers and leaves not crowded; stems thin and flexuous. 7. *S. occidentalis*

D. Sepals usually not transversely winged, but corniculate; leaves broadest at base; flowers usually in dense terminal inflorescences; branches stout.

E. Seeds 1.0-1.3 mm. broad; primarily of interior western American plains . . . . . 5. *S. depressa*

E. Seeds generally larger (1.2-2.0 mm. broad); plants of inland and south central California . . . . . 6. *S. depressa* var. *erecta*

B. Sepals rounded, may be carinate (keeled) and/or develop transverse wing when greatly inflated to the base of the sepal.

F. Sepals rounded, not usually carinate; branches decumbent; flowers in few-flowered glomerules along stem.

G. Seeds 1.8-2.0 mm. broad; leaves glaucous, acute, 0.5-5.0 cm. long; sepals rounded, may be obscurely carinate; Atlantic Coast and coastal Europe . . . . . 2. *S. maritima*

G. Seeds 1.25-1.50 mm. broad; leaves dark-green, blunt-tipped, 0.3-1.5 cm. long; sepals rounded, not carinate; along north Atlantic Coast of America . . . . . 3. *S. richii*

F. Sepals rounded and carinate, may also be transversely inflated or winged at the base; branches erect; flowers in panicles or subspicate inflorescences.

H. Sepals narrowly and evenly carinate, drying with the keel not unevenly crispate nor transversely winged; leaves linear, acute, not acuminate nor apiculate; along Atlantic Coast, Gulf of Mexico, West Indies . . . . . 4. *S. linearis*

H. Sepals broadly inflated, prolonged off obliquely at base, drying with transverse wing and/or crispate keel; leaves acuminate or apiculate; primarily of north central Mexico.

I. Plants branching from the base, 3-12 dm. tall; leaves not opposite, 1-4 cm. long, acuminate or apiculate; sepals not irregularly crispate on keel, nor developing corky-thickened appendages on keel or wing; seed ca. 0.8 mm. broad; plants of northern and central Mexico . . . . . 16. *S. mexicana*

I. Plants not branching conspicuously at the base, 1-3 dm. tall; lower leaves opposite, 1-2 cm. long, apex obtuse, apiculate; sepals irregularly crispate on keel, often also transversely winged and developing corky-thickened appendages; seed 1.1-1.3 mm. broad; endemic on salt flats at south end of Lake Jaco, Coahuila, Mexico . . . . . 17. *S. jacoensis*

A. Woody-based (suffrutescent) perennials, glabrous or pubescent; sepals cucullate (usually thickest at apex and broadly rounded over seed, not corniculate nor carinate).
  J. Plants pubescent through maturity, although calyx or leaves may not be.
    K. Calyx nearly or quite glabrous.
      L. Flowers 1-3 per axil; leaves glaucous, rounded at apex, 0.3-0.7 cm. long; plants may become completely glabrous with age; seed ca. 1.5 mm. broad. (See also under lead Q) . . . . . 13. *S. palmeri*
      L. Flowers 3-9 per axil; leaves green, acute, 0.3-1-3 cm. long; leaves may not remain pubescent; seed less than 1.5 mm. broad.
        M. Flowers 1.5-2.0 mm. broad, globose-obovoid; stem pubescent; seed ca. 1.0 mm. broad; along coast of southern Texas and eastern Mexico . . . . . 18. *S. tampicensis*
        M. Flowers 1.0-1.5 mm. broad, globose; leaves and stem pubescent; seed ca. 0.7 mm. broad; southwestern U.S. and northwestern Mexico . . . . . 15. *S. suffrutescens* var. *detonsa*
    K. Entire plant, including calyx and leaves, pubescent.
      N. Pubescence short; branches of inflorescence slender, spreading and flexuous; leaves linear, contracted at base, not crowded; flowers 1-3 per axil . . . . . 9. *S. torreyana* var. *ramosissima*
      N. Pubescence tomentulose or villous; branches stout, erect; leaves not contracted at base, crowded, or if not, flowers 3-9 per axil.
        O. Flowers 2.5-3.0 mm. broad, 1-2 per axil; leaves 1.0-2.5 cm. long, acute, leaving prominent knobby leaf bases. . . . . 11. *S. californica* var. *taxifolia*
        O. Flowers 1-2 mm. broad, more than 2 per axil; leaves 0.3-1.3 cm. long, may leave knobby leaf bases.
          P. Leaves 0.3-0.8 cm. long, obtuse or rounded apex, crowded, leaving prominent knobby leaf bases; flowers 1-3 per axil; coastal California and Lower California, Mexico. . . . . 12. *S. californica* var. *pubescens*
          P. Leaves 0.5-1.3 cm. long, acute, not crowded, reduced in the inflorescence, not leaving prominent knobby leaf bases; flowers 3-9 per axil, many staminate; southwestern U.S. and northern Mexico . . . . . 14. *S. suffrutescens*
  J. Plants glabrous when mature, or glaucous.
    Q. Leaves 1.0 cm. or longer, acute, green.
      R. Plants densely leafy, branches stout; leaves lanceolate, 1.5-3.0 cm. long; leaving prominent knobby leaf bases; flowers 2-3 mm. broad, 1-2 per axil; seed 1.5-2.0 mm. broad. . . . . 10. *S. californica*
      R. Plants not densely leafy, branches more slender and flexuous; leaves linear, acute, often reduced in inflorescence, contracted at the base, not leaving prominent knobby leaf bases; flowers 1.0-1.5 mm. broad, usually 3 per axil; seed 0.8-1.5 mm. broad. . . . . 8. *S. torreyana*
    Q. Leaves 0.2-0.8 cm. long, rounded at apex, glaucous.
      S. Plants entirely glabrous, glaucous; seed ca. 1.0 mm. broad; along Atlantic Coast of Texas and Mexico, West Indies. 19. *S. conferta*
      S. Plants pubescent with glabrous calyx when young, may become completely glabrous; seed ca. 1.5 mm. broad; north central Mexico. 13. *S. palmeri*

1. SUAEDA AMERICANA (Pers.) Fernald, Rhodora 9: 146. 1907.
Salsola salsa β *americana* Pers., Syn. Pl. 1: 296. 1805.
Chenopodium salsum β *americanum* (Pers.) Roem. and Schult., Syst. Veg. 6: 270. 1820.

Decumbent annual, glabrous; branches 2-3 dm. long, only the abundant flowering ones ascending; leaves green, becoming red as the plant matures in autumn; lower leaves linear, acute, to 2.0 cm. long, shorter and broader in the inflorescence; flowers in dense subspicate inflorescences, generally having an irregular calyx with one or two of the sepals more strongly hooded and corniculate than the others, occasionally with development of transverse wing at the base; seed horizontal, 1.0-1.5 mm. broad, black at maturity.

Type: From the lower St. Lawrence River, *Michaux s.n.* (Paris, Phototype!).

Matted sea-blite, American seepweed.

Occurs in salt marshes along the Atlantic Coast, Nova Scotia to New Jersey. Plants mature in late August to November.

TYPIFICATION: The type specimen, described by Michaux in 1803 as *Salsola salsa* ? L., was collected by Michaux at the mouth of the St. Lawrence River and examined by Fernald (1907) in the summer of 1903, at which time he noted:

> Loosely branching *Suaeda*, very immature, but from the crowding of the flowers seems to be the same as the Norwood Cove and Wells Beach (Maine) species of late September and October . . . This plant of Norwood Cove and Wells Beach is well characterized not only by its late fruiting and sub-prostrate habit but by its densely crowded flowers on spiciform branches, its very irregular calyx, and its rich claret-color in autumn; and it is apparently the plant intended by Persoon as *Salsola salsa*, var. ? *americana*.

In Michaux's 1803 publication he questionably identified the specimen from the St. Lawrence River as *Salsola salsa* L. and made the observation that it differed from the typical plant of Linnaeus in its low, subdecumbent habit with dense clusters of flowers. This was also the notation made by Persoon when he renamed the specimen var. ? *americana* in 1805.

Watson (1874) included *Salsola salsa* sensu Michaux, from the mouth of the St. Lawrence River, as a synonym under his *Suaeda linearis* var. *ramosa*. This had been treated as a synonym by Moquin-Tandon, and others, who doubtfully placed it under the more southern *S. linearis*. Fernald's exploration of the coast of Maine, and the lower St. Lawrence valley, and our examination of herbarium specimens, have shown that the tall, small-seeded *S. linearis* does not occur in central and northern Maine, nor the maritime provinces of Canada. We have found that typical *S. linearis* rarely occurs further north than New York, and in that state *S. linearis* and *S. americana* were often difficult to separate.

Britton apparently misapplied Persoon's name to the southern erect plant (*S. linearis*) under his combination *Dondia americana* (Pers.) Britton in 1896. Fernald was apparently correct in redefining the subdecumbent spiciform plant of the American North Atlantic coast as a new species of *Suaeda* through elevation of Persoon's variety and in employing the type and description referred to by Persoon.

SPECIMENS EXAMINED: CANADA, PRINCE EDWARD ISLAND: *Prince Co.:* Cape Aylesbury, *Fernald, Long and St. John 7416*, Aug. 29, 1912 (F, GH, MO, NY, UC). NEW BRUNSWICK: *Gloucester Co.:* Shippigan I., *Blake 5541*, Aug. 26, 1913 (GH, US). *Kent Co.:* Richibucto, *Blake 5716*, Sept. 22, 1913 (GH). *Northumberland Co.:* Fox I., *Blake 5694*, Sept. 18, 1913 (GH, US). *Westmoreland Co.:* Moncton, *Svenson and Fassett 1092*, Aug. 21, 1923 (GH). NOVA SCOTIA: *Colchester Co.:* mouth of Salmon R., Truro, *Fernald and Wiegand 3323*, Sept. 11, 1910 (GH). QUEBEC: Bonaventure, *Marie-Victorin, Rolland-Germain and Jacques 33348*, Aug. 13, 1930 (GH, NY). *River du Loup Co.:* Isle Verte, *Lepage 13975*, Sept. 2, 1957 (GH, US). UNITED STATES, MAINE: Norwood Cove, *Fernald s.n.*, Sept. 18, 1892 (GH). *York Co.:* Wells Beach, *Furbish s.n.*, Sept. 1898 (GH). Hancock Co.: Great Cranberry I., *Williams s.n.*, Aug. 8, 1910 (GH). NEW HAMPSHIRE: *Rockingham Co.:* Rye, *Rich s.n.*, Sept. 19, 1901 (GH). CONNECTICUT: *Fairfield Co.:* Stratford, *Eames s.n.*, Aug. 22, 1893 (NY, US). *New Haven Co.:* New Haven, *Cowles s.n.*, Aug. 12, 1892 (MU). MASSACHUSETTS: *Nantucket Co.:* Nantucket I., *Bicknell s.n.*, Sept. 11, 1907 (NY). *Dukes Co.:* Martha's Vineyard, *Bicknell 4023*, Sept. 29, 1929 (NY), *Middlesex Co.:* Cambridge, *Churchill s.n.*, Aug. 27, 1912 (MO). *Essex Co.:* Lynn, *Morong s.n.*, Sept. 7, 1875 (MO, NY). *Suffolk Co.:* S. Boston, *Dean s.n.*, Oct. 4, 1909 (GH). *Barnstable Co.:* Barnstable Harbor, Yarmouth, *Fernald 452*, Sept. 7, 1928 (F, GH, MO, NY, TEX, UC, US). *Bristol Co.:* Swansea, Touisset, *Deane and Rand s.n.*, Sept. 25, 1909 (GH). *Plymouth Co.:* Hingham Bridge, *Forbes s.n.*, Oct. 6, 1907 (TEX, UC). RHODE ISLAND: *Newport Co.:* Tiverton, *Greenman 1729*, Sept. 27, 1903 (GH, MO). NEW YORK: *Richmond Co.:* Staten I., *Kearney s.n.*, Oct. 8, 1893 (NY). *Suffolk Co.:* Aquebogue, Long I., *Young s.n.*, Sept. 1873 (F, NY, US). *Brooklyn Co.:* Barren I., Brooklyn, *Svenson 8237*, Oct. 26, 1936 (MO). NEW JERSEY: *Atlantic Co.:* Atlantic City, *Brinton s.n.*, Sept. 25, 1887 (F, MO). *Essex Co.:* Newark Bay, *Edwards s.n.*, Sept. 3, 1939 (NY). *Cape May Co.:* Cape May, *Witte s.n.*, Sept. 20, 1930 (NY). *Ocean Co.:* Pt. Pleasant, *Mackenzie 4819*, Oct. 2, 1910 (NY). *Monmouth Co.:* Keansburg, *Mackenzie 4480*, Sept. 26, 1909 (MO, NY).

2. SUAEDA MARITIMA (L.) Dumort., Fl. Belg. 22. 1827.
Chenopodium maritimum L., Sp. Pl. 221. 1753.
Atriplex maritima (L.) Crantz, Inst. 1: 208. 1766.
Salsola maritima (L.) Poir. in Lam., Encyc. 7: 291. 1806.
Schoberia maritima (L.) C. A. Meyer in Ledeb., Fl. Alt. 1: 400. 1829.
Chenopodina maritima (L.) Moq. in DC., Prodr. 13(2): 161. 1849.
Schoberia linifolia Nutt. ex. Moq. in DC., Prodr. 13(2): 161. 1849, as synonym.
Chenopodina maritima α *vulgaris* Moq. in DC., Prodr. 13(2): 161. 1849.
Lerchea maritima (L.) Kuntze, Rev. Gen. 549. 1891.
Dondia maritima (L.) Druce, Ann. Scot. Nat. Hist. 42. 1896.

Erect or decumbent annual (more robust than *S. richii*), 0.5-5.0 dm. tall;

leaves glaucous, linear, acute, semiterete, 0.5-3.0 (-5.0) cm. long, those of the inflorescence shorter yet much exceeding the 1-3 (-4) axiliary flowers; sepals pale-green, rounded or obscurely carinate; seed 1.8-2.0 mm. broad, red-brown to black at maturity.

Type locality: Seashores of Europe. Type material at Linnaean Herbarium and at British Museum of Natural History, not seen (phototype GH!).

White sea-blite.

Coastal, mostly growing in wet salt marshes, high tidal beaches or mud flats, Quebec to Florida, and coastal Europe.

SPECIMENS EXAMINED: CANADA, PRINCE EDWARD ISLAND: Souris R., *Marie-Victorin 9907*, Aug. 20, 1919 (F, GH, NY, US). *Queens Co.*: Rocky Point, *Fernald, Long and St. John 7414*, Aug. 31, 1912 (GH). *Prince Co.*: Summerside, *Fernald, Long and St. John 7412*, Aug. 7, 1912 (GH, US). NEW BRUNSWICK: *Charlotte Co.*: Grand Manan, *Weatherby and Weatherby 7315*, Aug. 14, 1944 (GH, NY, US). *Westmoreland Co.*: Moncton, *Blake 5739*, Sept. 30, 1913 (GH, NY, US). NOVA SCOTIA: *Lunenburg Co.*: Crescent Beach, *Zinck 1124*, Aug. 29, 1941 (F). *Shelburne Co.*: Villagedale, *Fernald, Long and Linder 21165*, Aug. 7, 1920 (GH). *Halifax Co.*: Purcell's Cove, Halifax Harbor, *Howe and Lang 1572*, Sept. 2, 1901 (GH, NY). *Yarmouth Co.*: *Fernald, Long and Linder 21170*, Sept. 7, 1920 (GH). *Digby Co.*: Digby, *Macoun 83976*, Aug. 26, 1910 (GH). *Annapolis Co.*: Annapolis Royal, *Fernald 2620*, Sept. 4, 1932 (GH). *Cape Breton Co.*: Cape Breton I., *Nichols 1585*, July 15, 1915 (GH). *Kings Co.*: Port Williams, *Fernald s.n.*, Aug. 23, 1902 (GH). QUEBEC: *Carlton Co.*: Bonaventure, *Marie-Victorin, Rolland-Germain and Jacques 33318*, Aug. 12, 1930 (GH, MU, NY).

UNITED STATES, MAINE: *Washington Co.*: Kelly Point, Pembroke, *Fernald 1744*, July 21, 1909 (US). *York Co.*: Old Orchard Beach, Ocean Park, *Wells s.n.*, Oct. 12, 1968 (MU). *Knox Co.*: Glencove, *Friesner 6188*, Aug. 10, 1933 (MU, TEX, UC, UT). *Lincoln Co.*: Penobscot Bay, *Steyermark 2178*, July 25, 1930 (F). PENNSYLVANIA: Greenwich Pt., Philadelphia, *Parker s.n.*, Sept. 9, 1874 (MO, NY). MASSACHUSETTS: *Norfolk Co.*: Hingham, *Churchill s.n.*, Oct. 6, 1888 (MO). *Essex, Co.*: Essex, *Knowlton s.n.*, Sept. 20, 1908 (UC). *Suffolk Co.*: Oak Island, Revere, *Brooks 1051*, Sept. 11, 1912 (UC). *Barnstable Co.*: Woods Hole, *Peters s.n.*, Aug. 1884 (NY). NEW HAMPSHIRE: *Strafford Co.*: cobble beach, Colony Cove, Durham Pt., Durham, *Hogdon, Smith and Smith 1137*, Sept. 13, 1941 (GH, MO, NY, OSU, TEX, UC, US). *Rockingham Co.*: Hampton, *Robinson 752*, Sept. 22, 1901 (F, GH). RHODE ISLAND: *Providence Co.*: Pautucket Neck, *Collins and Chamberlain s.n.*, Oct. 21, 1899 (GH, US). CONNECTICUT: *Fairfield Co.*: Housatonic R., *Eames 72*, Sept. 11, 1898 (GH). *New Haven Co.*: Milford, *Harger s.n.*, Aug 20, 1900 (GH). NEW YORK *Richmond Co.*: Prince's Bay, Staten I., *Kearney s.n.*, Oct. 6, 1894 (F, NY, US). *Nassau Co.*: Long I., *Muenscher and Curtis 6123*, Sept. 1, 1938 (US). *Suffolk Co.*: Huntington, *Muenscher and Curtis 6118*, Aug. 30, 1938 (GH). NEW JERSEY: *Ocean Co.*: Ocean City, *Benner s.n.*, Sept. 13, 1912 (GH). VIRGINIA: Ft. Monroe, *Vasey s.n.*, 1879 (MO). FLORIDA: *Wakulla Co.*: St. Marks Wildlife Refuge, *Godfrey 60361*, Sept. 30, 1960 (GH, NY, UC). *Hillsborough Co.*: 12 mi. n.w. Tampa, Double Branch Bay, *Ray and Lakela 11122*, July 15, 1962 (GH).

3. SUAEDA RICHII Fernald, Rhodora 9: 145. 1907.
Dondia richii (Fernald) A. Heller, Muhlenbergia 6: 83. 1910.

Decumbent annual, in mats 1-5 dm. in diameter; leaves dark-green, not glaucous, linear to linear-oblong, blunt, subterete, dorsally compressed, the lower leaves to 1.5 cm. long, those subtending fascicles of flowers broader and shorter (0.3-0.5 cm. long); sepals rounded on back, not carinate; seeds black at maturity, 1.25-1.50 mm. broad.

Type collection: Wells Beach, York Co., Maine, *J. C. Parlin and M. L. Fernald s.n.*, July 23, 1898 (US #1086836 !).

Rich's sea-blite.

Occurs in salt marshes along North Atlantic Coast, Newfoundland to Massachusetts.

SPECIMENS EXAMINED: CANADA, PRINCE EDWARD ISLAND: Tracadie Beach, *Churchill s.n.*, July 31, 1901 (MO). NEWFOUNDLAND: Avalon Peninsula, *Fernald, Long and Dunbar 26645*, Aug. 26, 1924 (GH). NOVA SCOTIA: Lehave R., *Macoun 83977*, Aug. 6, 1910 (F, GH). *Picton Co.:* Loch Broom, *Robinson 153*, Aug. 21, 1905 (NY).

UNITED STATES, MAINE: *York Co.:* Wells, *Deane 207*, Sept. 28, 1907 (F, GH, MO, NY, TEX, UC, US).

4. SUAEDA LINEARIS (Ell.) Moq., Chenop. Enum. 130. 1840.
   Chenopodium maritima Pursh, Fl. 198. 1814, not L.
   Salsola linearis (Ell.) Sk. 1: 332. 1817.
   Suaeda maritima Torr., Fl. N. Y. 2: 141. 1843, not Dumort.
   Chenopodina linearis (Ell.) Moq. in DC., Prodr. 13(2): 164. 1849.
   Chenopodina maritima Gray, Man. ed. 2. 366. 1856, not Moq.
   Suaeda linearis (Ell.) Wats., Proc. Amer. Acad. Arts Sci. 9: 87. 1874, in part.
   Suaeda linearis var. *ramosa* Wats., Proc. Amer. Acad. Arts Sci. 9: 87. 1874, excl. syn. *Salsola salsa* Michx. and *S. salsa* var. *americana* Pers.
   Dondia americana (Pers.) Britton in Britt. and Brown, Ill. Fl. 1: 584. t. 1393. 1896, excl. syn. *Salsola salsa* var. *americana* Pers.
   Dondia linearis (Ell.) Heller, Cat. N. Amer. Pl. 3. 1898.
   Dondia carinata Millsp., Field Columb. Mus. Publ. Bot. 2: 297. 1909. (Type: New Providence, Bahamas, *Northrop 150*, Jan. 1890, NY, not seen. Isotype, *Northrop 194*, NY!).

Erect or ascending annual, sometimes persisting in warm regions, 2-9 dm. high, profusely branched, the slender branches ascending or spreading, not decumbent; leaves narrowly linear, acute, not glaucous, dark-green, to 4 cm. long, shorter in slender elongated flowering branches; inflorescence usually a short, loose panicle; sepals equally carinate; seed black, 1.0-1.5 mm. broad.

Type: S. Carolina, as "*Chenopodium maritimum* Walt. Jul-Sept. in scirpetis maritimis", *Walter s.n.* (CHARL, not seen; phototype US!)

Southern sea-blite.

Occurs along the Atlantic Coast, New York to Yucatan peninsula of Mexico, and West Indies.

SPECIMENS EXAMINED: NEW YORK: *Kings Co.:* Bergen Beach, *Svenson 6365*, Sept. 28, 1934 (GH, MO, UC). *Suffolk Co.:* Southampton, Long

I., *Clute 309*, Sept. 3, 1898 (NY). NEW JERSEY: *Cape May Co.*: Cape May, *Witte s.n.*, Sept. 28, 1930 (NY). *Atlantic Co.*: Brigantine Beach, *Fogg 9535*, Aug. 26, 1935 (F). PENNSYLVANIA: Greenwich Point, Philadelphia, *Parker s.n.*, Sept. 9, 1874 (GH, MO, NY). NORTH CAROLINA: *Carteret Co.*: Swansboro, *Wood 6383*, July 28, 1946 (GH) *Dare Co.*: Hatteras, *Radford, Haeslop and Miller 7616*, Aug. 27, 1953 (GH). SOUTH CAROLINA: *Beaufort Co.*: Hunting I., *Bell 4776*, Sept. 6, 1956 (GH). *Georgetown Co.*: Georgetown, *Harris C19629*, July 28, 1919 (US). GEORGIA: *McIntosh Co.*: Sapelo I., *Duncan 20565*, Sept. 19, 1956 (F, GH, US). *Chatham Co.*: Tybee I., *Harper 747*, Sept. 29, 1900 (NY, US). FLORIDA: *Lee Co.*: Sanibel I., *Tracy 7624*, May 18, 1905 (F, GH, MO, NY, US). *Dade Co.*: Matheson Hammock, *Hawkes s.n.*, Sept. 18, 1947 (UC). *Brevard Co.*: Titusville, *Nash 2310*, July 30, 1895 (F, GH, MO, NY, US). *Pinellas Co.*: Long Key, *Thorne 9412*, Dec. 21, 1949 (UC). *Indian River Co.*: Vero Beach, *Lemaire 192*, Apr. 6, 1957 (GH). *Collier Co.*: Cape Roman, *Lakela and Barilotti 31047*, Aug. 16, 1967 (GH). *Franklin Co.*: Alligator Harbor, *Kral 2784*, July 18, 1956 (GH, NY). *Sarasota Co.*: Sarasota Bay, *Perkins s.n.*, Dec. 14, 1942 (GH). *Wakulla Co.*: St. Mark's Wildlife Refuge, *Godfrey and Kral 54106*, Oct. 6, 1955 (GH, NY). *Monroe Co.*: Saddlebunch Key, *Moldenke 813*, Mar. 20, 1930 (MO, MU, NY). ALABAMA: *Mobile Co.*: Mon Luis I., Mohr s.n., July 1867 (F, US). LOUISIANA: *Plaquemines Parish*: Breton I., *Tracy and Lloyd 492*, Aug. 18, 1900 (F, MO, NY, US). *Cameron Parish*: Cameron, *Cocks 1724*, Sept. 1906 (GH). *Terrebonne Parish*: Timbalier I., *Wurzlow s.n.*, July 25, 1914 (NY). TEXAS: *Cameron Co.*: 14 mi. from Pt. Isabel, Brownsville Road, *Ferris and Duncan 3085*, Aug. 1, 1921 (MO, NY). *Kenedy Co.*: El Toro I., *Tharp 49290*, June 16, 1949 (MO, NY, TEX, UC, US). *Willacy Co.*: Red Fish Bay, *Cory s.n.*, Nov. 16, 1940 (GH). *Galveston Co.*: Galveston Bay, *Lindheimer s.n.*, July-Aug. 1892 (GH, MO). *San Patricio Co.*: Ingleside, *Cory 45323*, July 25, 1944 (TEX). *Jefferson Co.*: 8 mi. west of Sabine Pass, *Cory 11056*, Oct. 5, 1934 (GH). *Brooks Co.*: Falfurgias, *Innes 317*, Nov. 23, 1941 (GH). *Calhoun Co.*: Port Lavaca, *Gentry 37*, Aug. 3, 1946 (F, GH, TEX). *Nueces Co.*: Mustang I., *Innes 378*, Nov. 29, 1940 (GH). *Brazoria Co.*: Brazoria Nat'l Wildlife Refuge, Canal, *Fleetwood 9078*, July 20, 1967 (TEX). *Hidalgo Co.*: East Donna, *Whitehouse 44238*, Aug. 20, 1944 (GH). *Pecos Co.*: E. Escondido Spr., *Tharp and Baker 3*, Sept. 29, 1943 (as *S. Tharpii*) (F, MO, TEX, UC, US).

BAHAMAS: Red Bay, Andros, *Northrop and Northrop 455*, Apr. 15, 1890 (F, GH, NY). North Bimini, *Howard and Howard 9990*, May 1948 (GH, NY). Eleuthera, Rock Sound, *Britton and Millspaugh 5563*, Feb. 21, 1907 (F, NY).

HAITI: Haiti, *Ekman 9886*, Apr. 25, 1928 (GH).

CUBA: Havana, *Baker 1406*, Aug. 26, 1904 (GH, NY). Salina de la Principal, Cayo Romano, Camaguey, *Shafer 2629*, Oct. 20, 1909 (F, GH, NY, US).

YUCATAN PENINSULA: Yaxactun, *Gaumer 23253*, March 1916 (F, GH, MO, NY, US). Chichankanab, *Gaumer 2219*, 1916 (F, GH, MO, UC, US). Celestun, *Schott 398*, May 12, 1865 (F). Progresso, *Steere 3090*, Aug. 11, 1932 (F).

5. SUAEDA DEPRESSA (Pursh) Wats., Bot. King's Expl. 294. 1871.

Salsola depressa Pursh, Fl. Amer. Sept. 197. 1814.

Chenopodium americanum (Pers.) Spreng., Syst. Veg. 1: 922. 1825, excl. first syn.

Chenopodium calceoliforme Hook., Fl. Bor. Amer. 2: 126. 1838 (Type: "About Carlton House Fort", *T. Drummond s.n.*, NY!).

Suaeda calceoliformis (Hook.) Moq., Chen. Enum. 128. 1840.

Chenopodina depressa (Pursh) Moq. in DC., Prodr. 13(2): 164. 1849.

Schoberia americana (Pers.) C. A. Meyer in Ledeb., Fl. Alt. 1: 402. 1829, as synonym.
Suaeda plattensis Nutt. ex Moq. in DC., Prodr. 13(2): 164. 1849. (Type: "Volcanic plains of the Missouri, *Nuttall s.n.*, not seen, description taken as type, PH or BM?).
Schoberia calceoliformis (Hook.) Moq. in DC., Prodr. 13(2): 166. 1849.
Lerchea calceoliformis (Hook.) Kuntze, Rev. Gen. Pl. 549. 1891.
Dondia depressa (Pursh) Britt. in Britt. and Brown, Ill. Fl. 1: 585. 1896.
Dondia calceoliformis (Hook.) Rydb., Bull. Torrey Bot. Club 39: 313. 1912.

Glabrous, simple to (more commonly) freely branched, procumbent to erect annual up to 8 dm. tall; leaves linear, mostly 1-3 (-4) cm. long, semiterete, reduced greatly in the inflorescence (where the leaves are mostly 2-3 mm. long), ovate to broadly lanceolate, usually somewhat broader than the lower leaves and sometimes hiding the flowers; spikes slender; flowers congested, 3-7 per axil in an often narrow panicle or in narrow stout spikes arising along the main branches most of their distance; sepals distinctly unequal, about 1.5 mm. long, all strongly hooded, often corniculate or corrugate-corniculate transversely upon drying; seed horizontal, about 1.0-1.3 mm. broad.

Type locality: ' On the volcanic plains of the Missouri River," *Nuttall s.n.* (PH or BM ?, not seen).

Pahute weed, Pursh's sea-blite, Pursh's seepweed.

Occurs on usually highly saline or alkaline soil, Alaska and Yukon, south into California, east of Cascades in Washington to Saskatchewan, Minnesota to Texas. Matures in July to September.

TYPIFICATION: The Nuttall specimen was not located, but most of those cited by Watson (1871) were seen, which included many plants collected on the American plains and very closely resembled descriptions by Pursh and Hooker.

All plants previously called *S. depressa* var. *erecta* were placed under the name *S. depressa*, with the exception of the California specimens noted under the treatment of *S. depressa* var. *erecta*. The varietal designation is retained for those plants because of their strictly erect habit, simple stems, and strict narrow inflorescences enclosed by the long, lanceolate leaves which allow a collector to distinguish them from typical *S. depressa*.

SPECIMENS EXAMINED: CANADA, N.W. TERRITORY: Ft. Smith, Mackenzie District, *Loan 306*, Aug. 21, 1950 (GH); Raup Lake, *Raup 2261*, Aug. 19, 1928 (GH). YUKON TERRITORY: Tagish, *Calder 28347*, Aug. 17, 1960 (UC). SASKATCHEWAN: Round Lake Valley, *Macoun and Herriot 76792*, Aug. 6, 1906 (GH, MO, NY). ALBERTA: Rosedale, *Moodie 1212*, Aug. 18, 1915 (F, GH, MO, NY). Craigmyle District, *Brinkman 735*, July 17, 1922 (GH). BRITISH COLUMBIA: Peace R. District, Bear L., *Groh 893*, Sept. 11, 1939 (UC); Richter Pass, Osoyoos, *McCabe 4625*, Aug. 30, 1937 (UC); Queen Charlotte I., *Calder and Taylor 35938*, July 14, 1964 (GH, MO, UC). MANITOBA: Winnipeg, *Macoun 12866*, Aug. 12, 1896 (NY); Carroll, *Senn and Gordon 3131*, Aug. 21, 1946 (MO).

UNITED STATES, ALASKA: Kenai Peninsula, *Calder 6681*, Aug. 13, 1951 (UC); Anchorage, *Murie s.n.*, Aug. 2, 1922 (US). MINNESOTA: *Clay Co.*: Barnesville, *Moore 23639*, Sept. 25, 1957 (US). *Kittson Co.*: Clow Township, *Moore and Moore 11576*, Aug. 9, 1939 (GH). *Lac Que Parle Co.*: Odessa, *Gleason 9398*, July 13, 1940 (NY). MISSOURI: Sheffield (introduced), *Bush 3885*, May 23, 1906 (GH, NY). NEBRASKA: *Lancaster Co.*: near Horse Cr., Scotts Bluff, *Rydberg 327*, Aug. 1, 1891 (NY, US). *Kearney Co.*: Mindon, *Hopeman 900*, Aug. 1895 (GH, US). *Dawson Co.*: Lexington, *Bates 4762*, Oct. 11, 1908 (GH). KANSAS: *Republic Co.*: salt marsh, Sect. 29, T4S, R2W, *Morley 1002*, Sept. 5, 1960 (NY, UC). *Barber Co.*: Hazelton, *McGregor 15088*, Aug. 31, 1959 (US). *Reno Co.*: Hutchinson, *Benke 2195*, Oct. 7, 1918 (F). SOUTH DAKOTA: *Spink Co.*: Redfield, *Ricksecker 105*, Aug. 10, 1903 (MU, UC). *Roberts Co.*: flood plain, *Over 15418*, Aug. 18, 1923 (US). *Kingsbury Co.*: Iroquois, *Thornber s.n.*, Aug. 10, 1894 (GH, UC). *Butte Co.*: Newell, *Stephens 45405*, Sept. 17, 1970 (NY, UC). *Harding Co.*: Antelope Valley, Visher 512, Aug. 6, 1912 (F). NORTH DAKOTA: *Nelson Co.*: Petersburg, *Stephens 45188*, Sept. 13, 1970 (NY). *Lamour Co.*: Edgeley, *Moore and Moore 10074*, Aug. 11, 1937 (GH, NY, UC). *Sargent Co.*: Gwinner, *Stephens 45048*, Sept. 11, 1970 (NY). *Ward Co.*: Minot, *Rider 359*, July 30, 1896 (F). *Benson Co.*: Leeds, *Lunell s.n.*, Sept. 1, 1899 (MU). *Grand Forks Co.*: Kellys Slough, Grand Forks, *Mabbott 504*, Sept. 20, 1917 (US). *Cass Co.*: Fargo, *Stevens 3044*, Sept. 4, 1967 (UC, US). *Pierce Co.*: Lake n.e. of Petrified L., *Mabbott 440*, Aug. 31, 1917 (US). *Sioux Co.*: Solen, *Stevens 1385*, Aug. 29, 1952 (UC, US). *Burleigh Co.*: McKensie Slough, Bismark, *Metcalf 351*, Aug. 24, 1917 (MO). *Mercer Co.*: Ft. Mandan, *Stevens 917*, Aug. 16, 1941 (UC, US). NEW MEXICO: *Chaves Co.*: Roswell, *Earle and Earle 311*, Aug. 19, 1900 (MO, NY, US). *San Juan Co.*: Farmington, *Standley 6896a*, July 7, 1911 (GH, NY, US). *Bernalillo Co.*: Albuquerque, *Herrick s.n.*, Sept. 13, 1894 (NY, US). TEXAS: *Wilbarger Co.*: Red River, *Ball 1231*, Sept. 1880 (F, MO). ARIZONA: *Coconino Co.*: Tuba City, *Darrow 2762*, Aug. 24, 1945 (UC). OKLAHOMA: *Cleveland Co.*: Norman, *Shead s.n.*, Sept. 17, 1954 (GH, UC). *Jackson Co.*: Altus, *Hopkins 1012*, Oct. 24, 1936 (GH, US). *Alfalfa Co.*: Salt Plains Wildlife Refuge, *Nighswonger 428*, Oct. 6, 1968 (TEX). COLORADO: *Alamosa Co.*: Alamosa, *Talbot 353*, Aug. 19, 1926 (UC). *Montrose Co.*: Montrose, *Shear 4930*, July 22, 1897 (NY, US). *Fremont Co.*: Canyon City, *Shear 3448*, Aug. 7, 1896 (NY). *Chaffee Co.*: Buena Vista, *Sheldon 255*, July 20, 1892 (US). *Larimer Co.*: Ft. Collins, *Cowen 2228*, Sept. 3, 1893 (MO, NY). *Mesa Co.*: Grand Junction, *Underwood and Selby 508*, Sept. 15, 1901 (NY). *Park Co.*: Hartsel Jct., *Weber 12930*, Aug. 11, 1965 (UT). *Gunnison Co.*: Stevens Cr., Gunnison, *Hall 251*, July 4, 1961 (UT). WYOMING:*Albany Co.*: alkali flats, Laramie, *Nelson 8677*, Sept. 1902 (F, GH, MO, NY, UC, US). *Carbon Co.*: alkali flats, Hanna, *Nelson 8161*, Aug. 31, 1900 (GH, MO, NY, US). *Sweetwater Co.*: Lost Creek, *Ownbey and Lang 1087*, Aug. 9, 1936 (MO). *Uinta Co.*: Ft. Bridger, *Hopeman s.n.*, Sept. 2, 1919 (MO). *Johnson Co.*: Buffalo, *Tweedy 3286*, Sept. 1900 (NY). MONTANA: *Big Horn Co.*: Crow Agency, *Hayden and Porter 67*, Aug. 8, 1871 (GH, NY). *Dawson Co.*: Colgate, near Glendive, *Sandberg 1034*, Sept. 6, 1892 (GH, NY, US). *Lewis and Clark Co.*: Helena, *Kelsey s.n.*, Sept. 21, 1891 (MU, NY). *Lake Co.*: Polson, *Umbach 260*, Aug. 19, 1901 (F, NY, US). *Philips Co.*: Malta, Alkali L., *Blankinship 126*, Aug. 24, 1890 (GH, US). *Blaine Co.*: Havre, *Muenscher 11471*, Sept. 5, 1937 (MO, NY). IDAHO: *Bear Lake Co.*: Bear Lake, *Davis 1822*, Sept. 1, 1937 (F). *Custer Co.*: May, *Hitchcock and Muhlich 11302*, Aug. 20, 1944 (NY, UC). *Owyhee Co.*: Grandview, *Davis 4232*, Aug. 19, 1941 (F, UC). *Lemhi Co.*: Salmon, *Christ 5854*, July 20, 1934 (NY).

Bannock Co.: Pocotello, *Christ 8369*, July 12, 1937 (NY). *Franklin Co.*: Preston, *Davis 4062*, Aug. 21, 1941 (F). *Bingham Co.*: Springfield, *Davis 1493*, July 29, 1939 (F, UC). *Gem Co.*: Emmett, *Christ 8550*, Aug. 6, 1937 (NY). *Payette Co.*: Falk Station, *Christ and Christ 16862*, June 14, 1947 (NY). NEVADA: *Washoe Co.*: Glendale, *Kennedy 1952*, Sept. 26, 1912 (F, GH, MO, NY, US). *Elko Co.*: Salt plains, *Hitchcock 1123*, Aug. 25, 1897 (GH, MO, NY). *Churchill Co.*: Carson Sink, *Kennedy 1700*, Oct. 1907 (F, GH, MO, NY, UC, US). *Humboldt Co.*: northern Nevada, *Griffiths and Morris s.n.*, July 1901 (NY). UTAH: *Rich Co.*: Woodruff, *Flowers F3-33*, Aug. 19, 1933 (F, UT). *Cache Co.*: *McHugh s.n.*, July 29, 1955 (NY). *Davis Co.*: Farmington Bay Refuge, *Piranian and Hobson 14836*, Sept. 18, 1936 (UC). *Box Elder Co.*: Bear R. Refuge, *Hobson 14805*, Sept. 10, 1936 (UC). *Salt Lake Co.*: State Prison, *Arnow 3856*, Sept. 30, 1973 (UT). *Millard Co.*: Scipio, *Goodding 1506*, Aug. 13, 1935 (UT). *Utah Co.*: Provo, *Galway and Harrison 10836*, Sept. 13, 1944 (F, UC). *Sanpete Co.*: Ephraim, *Eggleston 10261*, July 25, 1941 (US). *Summit Co.*: Park City, *James s.n.*, Aug. 15, 1887 (GH). *Weber Co.*: sand flat, n. of Little Mt., *Arnow 803*, Oct. 25, 1967 (UT). *Duchesne Co.*: Duchesne, *Harrison and Garrett 8889*, Sept 2, 1938 (F, UC). *Carbon Co.*: Saline flats, Price, *Flowers 836*, Sept. 18, 1927 (UT). *Grand Co.*: Arches Nat'l Mon., *Welsh and Moore 2722*, Sept. 28, 1963 (NY). WASHINGTON: *Whatcom Co.*: Birch Bay, *Muenscher 7753*, Aug. 23 1937 (F, GH, MO, NY, US). *Grant Co.*: Soap Lake, *Eyerdam 6365*, Aug. 12, 1943 (UC). *Lincoln Co.*: Irby, *Elmer 1241*, Sept. 1898 (US). *Okanogan Co.*: alkali soil between Omak and Okanogan, *Fiker 1425*, Sept. 15, 1933 (NY, US). *Klickitat Co.*: Bingen, *Suksdorf s.n.*, Aug. 1906 (NY). *Kitsat Co.*: Keyport, *Eyerdam 1181*, Aug. 7, 1937 (MO). *Island Co.*: Coupeville, *Gardner s.n.*, 1899 (UC, UC-JEP). *Mason Co.*: Hoodsport, *Jones 8625*, Oct. 12, 1935 (GH). OREGON: *Lake Co.*: Summer L., *Thompson s.n.*, Sept. 25, 1974 (MU). *Klamath Co.*: mouth of Williamson R., *Coville 1257*, Aug. 7, 1902 (US). *Harney Co.*: Harney Valley, *Cusick 2044*, July 18, 1898 (F, GH, MO, UC, US). CALIFORNIA: *Modoc Co.*: McGinty Point, Goose Lake, *Wheeler 3942*, Sept. 4, 1935 (GH, MO, NY). *Siskiyou Co.*: Lower Klamath Lake, *Hopkins s.n.*, Sept. 2, 1974 (MU). *Mono Co.*: Bridgeport, *Nobs and Smith 1691*, Aug. 31, 1949 (NY, UC). *Santa Cruz Co.*: San Juan Bautista, *Belshaw 2199*, May 22, 1936 (UC). *Santa Barbara Co.*: Carpenteria, *Pollard s.n.*, Sept. 9, 1964 (TEX). *Ventura Co.*: Oxnard, *Davy 7788*, 1901 (UC). *Santa Clara Co.*: Milpitas, *McMinn 117*, Sept. 20, 1924 (UC). *Inyo Co.*: Death Valley, Ash Meadows Road, *Roos and Roos 6236*, Sept. 14, 1954 (UT). *Lassen Co.*: Honey Lake Valley, *Davy 3350*, June 17, 1897 (UC).

6. SUAEDA DEPRESSA var. ERECTA Wats., Proc. Amer. Acad. Arts Sci. 9: 90. 1874.
   Suaeda minutiflora Wats., Proc. Amer. Acad. Arts Sci. 18: 194. 1883. (Type coll.: Santa Barbara, Calif., *Cooper s.n.*, 1879, GH!).
   Dondia minutiflora (Wats.) Heller, Cat. N. Amer. Pl. 3. 1898.
   Dondia depressa var. *erecta* (Wats.) Heller, Cat. N. Amer. Pl. 3. 1898.
   Dondia erecta (Wats.) A. Nels., Bot. Gaz. 34: 364. 1902.
   Suaeda erecta (Wats.) A. Nels. in Coult. and Nels., Man. Bot. Rocky Mts. 169. 1909.

Glabrous, 3-7 dm. high, the branches mostly simple below, erect; leaves linear or lance-linear, broadest at base, 1.5-4.0 cm. long; inflorescence leaves shorter and broader at base; inflorencence branches stout, short and erect, mostly crowded; flowers clustered in axils; sepals irregularly

corniculate, strongly hooded; seed black, 1.2-2.0 mm. broad.

Type: Santa Barbara, Calif., *E. Cooper s.n.*, 1879 (GH!).

Occurs in inland areas of central and southern California.

SPECIMENS EXAMINED: CALIFORNIA: *Santa Barbara Co.*: Santa Barbara, *Pollard s.n.*, Oct. 8, 1957 (NY, UC). *Los Angeles Co.*: Los Angeles, *Nevin 727*, 1882 (NY, UC). *Orange Co.*: e. of Long Beach, Bryant Ranch, *Wolf 3786*, June 28, 1932 (UC, US). *Inyo Co.*: Amargosa Desert, *Roos and Roos 6236*, Sept. 14, 1954 (GH, NY, UC, US, UT). *San Bernardino Co.*: San Bernardino, *Parish 4200*, Sept. 25, 1896 (F, GH, MO, NY, UC, US). *Riverside Co.*: near Santa Ana R., Riverside, *Hall 52*, Sept. 26, 1905 (F, GH, MO, NY, OSU, UC).

7. SUAEDA OCCIDENTALIS Wats., Proc. Amer. Acad. Arts Sci. 9: 90. 1874.
Schoberia occidentalis Wats., Bot. King's Expl. 295. 1871.
Dondia occidentalis (Wats.) Heller, Cat. N. Amer. Pl. 3. 1898.

Simple and erect to freely branched and spreading-erect, glabrous, yellowish-green annual, 1-3 dm. tall; branches flexuous, ascending or spreading; leaves numerous, linear, subterete, 0.5-3.0 cm. long, 1.0-1.5 mm. broad, acute to acuminate, reduced gradually in the inflorescence, the leaves there little if at all broader than the lower leaves, 2-4 mm. long; spikes ultimately open, the glomerules of 2-3 flowers not congested along the slender branches; sepals usually distinctly unequal, one or more usually more prominently cross-corrugate than the others, but all somewhat hooded, and often irregularly transverse winged in age, about 1 mm. long, obtusely lobed; seed horizontal, about 1 mm. broad.

Type: From Ruby Valley, Nevada, *Watson 999*, Sept. 1868 (US #49417!).

Slender sea-blite, western seepweed.

Occurs in saline or alkaline flats and marshes in the sagebrush areas of the Great Basin, southeastern Oregon, central Washington, eastern Utah through eastern Idaho, to southern Wyoming, Colorado. Matures in late June to August.

SPECIMENS EXAMINED: WASHINGTON: *Okanogan Co.*: Tonasket, *Thompson 8688*, July 2, 1937 (GH). IDAHO: *Canyon Co.*: Caldwell, *Jensen s.n.*, 1901 (US). OREGON: *Harney Co.*: eastern Oregon near Nevada line, *Cusick 2031*, July 12, 1898 (F, GH, MO, UC, US). *Lake Co.*: Silver L., *Cusick 2726*, Aug. 5, 1901 (F, GH, MO, NY, UC). CALIFORNIA: *Lassen Co.*: Litchfield, *Hoover 4641*, Sept. 29, 1940 (UC, US). NEVADA: *Elko Co.*: Humboldt Valley, *Watson 997*, Sept. 1868 (GH, NY, US). *Washoe Co.*: Spanish Spring, *Hendrix 876*, Aug. 16, 1938 (UC). *Douglas Co.*: alkali flat, Wellington Quadrangle, *Johannsen 1282*, Sept. 20, 1937 (UC). *Nye Co.*: Potts Ranger Station, *Smith s.n.*, Aug. 10, 1939 (NY). *Lander Co.*: Austin, *Goodner and Henning 873*, July 27, 1937 (TEX). UTAH: *Salt Lake Co.*: salt flats, Salt Lake City, *Jones 1329*, Aug. 25, 1879 (F, NY). *Davis Co.*: west of Syracuse, *Arnow 3809a*, Sept. 3, 1973 (UT). *Utah Co.*: east of Spanish Fork, *Harris C27437*, July 30, 1927 (F, GH, MO). *Tooele Co.*: Great Salt Lake, *Flowers 992*, Aug. 8, 1929 (UT). WYOMING: Gros Ventre River, *Forwood s.n.*, July 31, 1881 (US). *Lincoln Co.*: at Hams Fork and La Barge, *Curtis s.n.*, July 13, 1900 (NY).

8. SUAEDA TORREYANA Wats., Proc. Amer. Acad. Arts Sci. 9: 88. 1874.
Chenopodium maritimum Torr., Ann. Lyc. N. Y. 2: 239. 1828, not *S. maritima* (L.) Dumort. (Type: upper part of Canadian R., New Mexico, ? *James 2*, NY!).
Chenopodium nigrum Raf., Atl. Jour. 146. 1832. *(nomen nudum).*
Chenopodina linearis Torr. in Stansbury, Expl. Utah 394. 1853, not *C. linearis* Moq. 1849. Type: from mountains on west shore of Great Salt Lake, Utah, *Stansbury* [Salt Lake Expedition] *s.n.*, May 30, 1850, NY!).
Suaeda fruticosa var. *?multiflora* Torr., Pac. R. R. Rep. 4: 130. 1857. (Type: Llano Estacado, Ft. Smith to Rio Grande (Tucumcari), New Mexico, *Bigelow s.n.*, Sept. 15, 1853, US #63412!).
Chenopodina moquini Torr., Pac. R. R. Rep. 7(3): 18. 1858, homonym.
Suaeda fruticosa Wats., Bot. King's Expl. 294. 1871, not *S. fruticosa* Forsk. 1775. (Type: central Wyoming, Sweetwater R., *Fremont 622*, NY!).
Suaeda maritima (Torr.) Wats., Bot. King's Expl. 294. 1871, not *S. maritima* (L.) Dumort. 1827.
Suaeda diffusa Wats., Proc. Amer. Acad. Arts Sci. 9: 88. 1874 (Type: from Truckee Valley, n.w. Nevada, *Bailey (Watson) 996*, Aug. 1867, GH!).
Suaeda intermedia Wats., Proc. Amer. Acad. Arts Sci. 14: 296. 1879. (Type: from central Utah, *C. C. Parry 84*, 1875, GH!).
Suaeda moquini (Torr.) Greene, Pittonia 1: 264. 1889.
Dondia multiflora (Torr.) Heller, Cat. N. Amer. Pl. 3. 1898.
Dondia diffusa (Wats.) Heller, Cat. N. Amer. Pl. 3. 1898.
Dondia intermedia (Wats.) Heller, Cat. N. Amer. Pl. 3. 1898.
Dondia moquini (Torr.) Nelson, Bot. Gaz. 34: 363. 1902.
Dondia wilsonii Millsp., Field Columb. Mus. Publ. Bot. 2: 297. 1909. (Type: from S. Caicos I., Bahamas, *Percy Wilson 7616*, Dec. 14-16, 1907, NY!).
Dondia fruticosa (Wats.) Standley, N. Amer. Fl. 21: 90. 1916.
Dondia nigra (Raf.) Standley, N. Amer. Fl. 21: 89. 1916.
Dondia torreyana (Wats.) Standley, N. Amer. Fl. 21: 90. 1916.
Suaeda nigra (Raf.) Macbride, Contrib. Gray Herb. n.s. 56: 50. 1918.

Perennial, glabrous, 2-8 (-10) dm. high, freely branched, ascending slender branches from a short woody base; leaves linear, with a contracted base and acute tip, 0.5-3.0 cm. long, not crowded (usually at least 2 mm. between nodes), usually reduced in the somewhat paniculate inflorescence, although some plants have glomerules of flowers at the base of the larger leaves below; flowers 1-5 per axil (usually 3, with the center flower larger and functionally staminate); calyx glabrous, cucullate, the lobes cleft more than halfway; seeds 0.8-1.2 (-1.5) mm. broad, black, shiny, vertical or horizontal.

Lectotype (selected by Lundell, 1969): From mountains on west shore of Great Salt Lake, Utah, *Stansbury Expedition s.n.*, May 30, 1850 (NY!).

Torrey sea-blite, alkali seepweed.

Occurs in alkaline soil of interior plains, Oregon to Alberta, south to Baja California, Mexico, east to Texas and West Indies. Plants mature from July to September.

TYPIFICATION: Standley (1916) separated this complex of the American plains into three species: *Suaeda nigra, S. fruticosa,* and *S. torreyana.* Examination of types and other cited specimens revealed no essential differences in the calyx types, floral arrangement, leaf characters, and habit. Whether or not the species are annual or perennial is a difficult character, since most of the type specimens are fragments of floral branches. Examination of sets of entire specimens revealed the plants were herbaceous from a woody base. The thickness of the leaf varies with alkalinity of the habitat, but all specimens have acute leaf tips and narrowed bases, whether or not the leaf is very flat, semiterete, or round. Floral characters seem consistent over the range, with a deeply cleft, cucullate calyx. Within a glomerule, the central flower is usually functionally staminate, larger, and has acute sepals, while the two lateral pistillate flowers have more obtuse tips. Seed characters appear consistent.

In his original publication Watson (1874) named several collections to represent his species *S. diffusa* (an annual) and *S. torreyana* (a perennial). Of these, Lundell (1969) selected the plant collected on the Stansbury expedition as lectotype, although the specimen does not have mature flowers. This specimen was also noted by Torrey (1853), but misnamed *Chenopodina linearis. Suaeda diffusa* was not selected as the species name since it has been used as a synonym for *S. nigra,* a superfluous name, by Rafinesque as *Chenopodium nigrum.* The specimen taken as type for *C. nigrum* was collected along the upper Canadian River in New Mexico and named *Chenopodium maritima* by Torrey (1828); it is a sterile fragment. The designation *S. torreyana* is preferred in this treatment over *S. fruticosa,* an extensively ranging Old World species, until their true relationship is established.

SPECIMENS EXAMINED: CANADA, ALBERTA: Milk River, *Macoun 12934,* July 10, 1895 (F, NY).

UNITED STATES, NORTH DAKOTA: *Billings Co.*: Sullys Spring, *Stevens 1290,* Aug. 10, 1951 (US). *McKenzie Co.*: n. T. Roosevelt Park, *Stevens 722,* July 16, 1943 (MO, UC). SOUTH DAKOTA: *Harding Co.*: Cave Hills, *Visher 191,* Aug. 2, 1910 (F). *Pennington Co.*: Badlands, *Canby s.n.,* Aug. 12, 1882 (GH, NY). MONTANA: *Wheatland Co.*: 10 mi. e. of Harlowton, *Hitchcock 2426,* Aug. 1934 (MO). *Rosebud Co.*: Birney, *Bennett s.n.,* July 28, 1957 (F, NY, UC, US). IDAHO: *Owyhee Co.*: Bruneau, *Christ 11130,* June 1, 1940 (NY). *Canyon Co.*: Caldwell, *Christ 14190,* July 2, 1943 (NY). *Elmore Co.*: Glenns Ferry, *Christ and Ward 10312,* June 22, 1939 (NY). *Ada Co.*: Grandview, *Davis 2062,* June 18, 1940 (F). OREGON: *Harney Co.*: Malheur R., *Cusick 1939,* June 18, 1898 (F, GH, MO, UC, US). NEBRASKA: Ft. Union, *Hayden s.n.,* 1854 (MO). WYOMING: *Albany Co.*: Big Hollow, *Goodman 4448,* July 11, 1947 (TEX). *Sheridan Co.*: Ucross, *Nelson 9753,* Aug. 1916 (MO). *Fremont Co.*: Green River, *Shear 3346,* June 1895 (NY). *Sweetwater Co.*: n. Rock Springs, *Ownbey and Lang 1146,* Aug. 19, 1936 (MO). COLORADO: *Moffat Co.*: Yampa R., 10 mi. w. of Maybell, *Porter and Porter 3674,* July 11, 1945 (GH, MO, TEX, UC). *Montrose Co.*: Naturita, *Payson and Payson 3880,* June 28, 1924 (GH, MO, UC). *Montezuma Co.*: Mancos,

Baker, Earle and Tracy 421, July 8, 1898 (GH, MO, NY, US). *Mesa Co.*: Grand Junction, *Baker 925*, Aug. 25, 1901 (GH, MO, NY, UC). *El Paso Co.*: Manitou Springs, *Engelmann s.n.*, Sept. 1, 1881 (MO). *Fremont Co.*: n. Canon City, *Bacigalupi 1053*, Aug. 29, 1924 (GH). UTAH: *Box Elder Co.*: Brigham City, *Zundell 247*, June 19, 1910 (NY). *Tooele Co.*: 1½ mi. s. of Timpie Station, *Arnow 511*, Aug. 6, 1967 (MO, UT). *Juab Co.*: Troutcreek, *Maguire and Richards 2576*, Aug. 27, 1933 (UC). *Millard Co.*: Hatton, *Davis D2572*, June 4, 1930 (UT). *Kane Co.*: Warm Cr. Rd. near Lake Powell, *Collotzi 1046*, Aug. 30, 1967 (NY). *Garfield Co.*: Escalente, *Welsh and Welsh 9412*, Sept. 5, 1969 (NY). *Wayne Co.*: Fruita, *Maguire 19296*, July 1, 1940 (NY). *Emery Co.*: San Raphael Bridge, *Harrison 9809*, Aug. 21, 1940 (US). *Utah Co.*: Spanish Fork, *Harris C27436*, July 30, 1927 (F). *Salt Lake Co.*: Salt Lake, *Garrett 5009*, Oct. 7, 1928 (F, UC, UT). *Cache Co.*: saline flats, *Flowers 208*, July 1924 (UT). *Duchesne Co.*: Duchesne R., e. of Myton, *Welsh, Murdock and Shaw 9435*, Sept. 20, 1969 (NY, UT). *Carbon Co.*: Helper, *Coville and Kearney 2602*, Aug. 1899 (US). *Uintah Co.*: 20 mi. s. Vernal, *Graham 6112*, June 19, 1931 (F, MO). *Sevier Co.*: 7 mi. e. Salina, *Anderson 951*, Aug. 25, 1958 (NY, UC). *San Juan Co.*: Navajo Spring, *Cutler 3013*, Aug. 31, 1939 (GH, MO, NY). NEVADA: *Elko Co.*: Salt Spring, Pilot Mt., *Holmgren 1601*, July 31, 1941 (GH, NY, UC, US). *Humboldt Co.*: Humboldt L., *Watson 998*, May 1868 (GH, NY). *Washoe Co.*: Pyramid L., *Train 2605*, Oct. 28, 1938 (NY). *Churchill Co.*: Carson L., *Tidestrom 10784*, July 30, 1919 (NY, US). *Nye Co.*: Amargosa, *Beatley 9350*, July 16, 1969 (NY). *Esmeralda Co.*: Fish Lake Valley, *Archer 7243*, Sept. 25, 1938 (F, MO, NY). *Lincoln Co.*: Crystal Spring, *Train 2412*, Aug. 30, 1938 (NY). *Storey Co.*: Truckee Valley, *Bailey* (Watson) *996*, Aug. 1867 (GH, NY, UC, US). CALIFORNIA: *Lassen Co.*: Honey Lake Valley, *Davey 3325*, June 17, 1897 (UC). *Contra Costa Co.*: Byron Hot Springs, *Wiggins 4585*, April 17, 1930 (UC). *Tulare Co.*: Goshen, *Congdon s.n.*, Sept. 1881 (NY). *San Joaquin Co.*: Lathrop, *Congdon s.n.*, Aug. 26, 1887 (UC). *Alameda Co.*: Livermore, *Howell 11441*, July 20, 1933 (F, GH, MO, US). *Madera Co.*: Chowchilla, *Hoover 1611*, Oct. 1, 1936 (UC). *Fresno Co.*: near Kerman Jct., *Bacigalupi 2668*, July 29, 1941 (GH, UC). *Merced Co.*: Los Banos Wildlife Refuge, *Nobs and Smith 22*, July 8, 1948 (UC). *Inyo Co.*: Deep Spring Lake, *Duran 3308*, June 17, 1932 (UC). *Kern Co.*: Delano, *Wieslander 484*, May 1, 1934 (UC). *Los Angeles Co.*: Long Beach, *McClatchie s.n.*, May 30, 1891 (NY). *San Luis Obispo Co.*: Cuyama Ranch, *Peterson 353*, July 9, 1936 (UC). *San Bernardino Co.*: alkaline flats, Loma Linda, *Munz and Johnston 8909*, July 29, 1924 (GH, NY). *Riverside Co.*: Perris, *Howell 4786*, May 10, 1930 (MO). *Orange Co.*: Newport Bay, *Booth 1247*, July 4, 1932 (UC, UC-JEP). *San Diego Co.*: Chula Vista, *Abrams 4191*, Sept. 10, 1904 (F, GH, MO, NY). *Ventura Co.*: Pt. Magu, *Howell 3789*, May 19, 1928 (NY). *Santa Barbara Co.*: Cuyama Beach, *French 720*, Feb. 26, 1936 (UC). ARIZONA: *Maricopa Co.*: Guadalupe to Montezuma Head, *Killip 40848*, Jan. 19, 1951 (US). *Pinal Co.*: Sacaton, *Harrison and Kearney 9056*, Aug. 31, 1932 (F). *Pima Co.*: Tucson, *Griffiths 2104*, Nov. 15, 1900 (NY). *Coconino Co.*: Tuba City, *Kearney and Peebles 12878*, Sept. 27, 1935 (US). *Navajo Co.*: Winslow, *Griffiths 5003*, July 8, 1903 (MO). *Yuma Co.*: Mohawk, *Peebles 12923*, Oct. 12, 1935 (US). *Gila Co.*: saline bottoms, Whites Mills, Gila R., *Palmer 216*, Sept. 8, 1867 (GH, MO). NEW MEXICO: *San Juan Co.*: Shiprock, *Standley 7206*, July 25, 1911 (US). *Otero Co.*: Tularosa, *Birum s.n.*, Oct. 12, 1931 (UC). *Chaves Co.*: Hagerman, *Benke 5023*, April 27, 1929 (F). TEXAS: *Oldham Co.*: Tascosa, *Reverchon 2946*, June 24, 1902 (MO). *Gonzales Co.*: *Tharp 78*, May 21, 1936 (MO, UC).

Pecos Co.: Llano Estacado, *Bigelow s.n.*, Sept. 15, 1853 (US). *Cameron Co.*: Boca Chica, *Muenscher and Muenscher 14403*, Feb. 26, 1939 (NY, US).

MEXICO, SINALOA: Escuinapa, *Ortega 5180*, 1923 (US). BAJA: 24 mi. s. Punta Prieta, *Wiggins 7739*, Feb. 23, 1935 (F, US). SONORA: Altar, *Wiggins 5992*, Oct. 22, 1932 (F, US). CHIHUAHUA: Bolson de Mapini and Cienega Grande, Saladillo, *Gregg 458*, Sept. 20, 1848 (GH, MO).

CUBA: Salinas de Caimanera, *Hioram 3941*, Aug. 24, 1920 (NY).

BAHAMAS: S. Caicos I., *Wilson 7616*, Dec. 14-16, 1907 (F, GH, NY).

9. SUAEDA TORREYANA var. RAMOSISSIMA (Standley) Munz, Man. S. Calif. Bot. 144. 1935.
Suaeda suffrutescens Wats., Bot. Calif. 2: 59. 1880, in part.
Dondia ramosissima Standley, N. Amer. Fl. 21: 91. 1916.
Suaeda ramosissima (Standley) Johnston, Proc. Calif. Acad. Sci. Ser. 4. 12(30): 1017. 1924.

Densely short-pubescent throughout, otherwise similar to typical *S. torreyana*.

Type: Lees Ferry, Arizona, *E. W. Nelson 62*, Aug. 24, 1909 (US #564515!).

Bush seepweed.

Occurs in alkaline areas in the interior hot dry deserts, Oregon to Nevada, Utah, California, and northern Mexico.

SPECIMENS EXAMINED: UNITED STATES, OREGON: Malheur Valley, *Griffiths and Morris 709*, Aug. 15, 1901 (MO). NEVADA: *Clark Co.*: Las Vegas, *Gullion 473*, May 4, 1953 (UC). *Nye Co.*: Amargosa Drainage, near Spring Meadows Farm, *Beatley 9794*, Oct. 11, 1969 (NY). *Washoe Co.*: Pyramid L., *Tidestrom 10680*, July 24, 1919 (NY, US). *Douglas Co.*: Topaz, *Hendrix 1091*, June 16, 1939 (UC). *Humboldt Co.*: northern Nevada, *Train 15910*, June 17, 1934 (MU). UTAH: *Tooele Co.*: *Garrett 2773*, June 17, 1914 (F, UT). *Salt Lake Co.*: Salt Lake, *Harrison 317H*, July 12, 1939 (UC). *Millard Co.*: Painter Spring, *Fautin 8930*, June 29, 1939 (UC). *Washington Co.*: St. George, *Cottam 3379*, June 21, 1928 (UT). NEW MEXICO: *Lincoln Co.*: 4 mi. n. Tularosa, *Wooton and Standley s.n.*, Aug. 19, 1907 (US). ARIZONA: *Yuma Co.*: Yuma, *Harter s.n.*, Sept. 20, 1906 (US). *Navajo Co.*: Holbrook, *Rusby 382*, Aug. 20, 1883 (NY). *Coconino Co.*: Lees Ferry, *Nelson 62*, Aug. 24, 1909 (US). CALIFORNIA: *Los Angeles Co.*: Lancaster, *Elmer 3672*, June 1902 (F, GH, NY). *Inyo Co.*: Lone Pine, *Jepson 5122*, July 24, 1912 (UC-JEP). *San Bernardino Co.*: 1 mi. w. Old Woman Spring, *Munz and Johnston 11199*, Sept. 5, 1928 (F). *Fresno Co.*: 23 mi. n.-n.w. of Fresno, San Joaquin R., *Quibell 2292*, June 9, 1953 (UT). *Kern Co.*: Bakersfield, *Eastwood s.n.*, Oct. 4, 1894 (GH). *Riverside Co.*: Salton Basin, Indio, *Parish 8268*, Oct. 8, 1912 (GH, UC, UC-JEP). *Imperial Co.*: Holtzville, *Keller s.n.*, Nov. 11, 1937 (GH, UC). *Tulare Co.*: Earlmont, *Ferris and Rossbach 9670*, May 21, 1938 (GH). *Merced Co.*: Los Banos, *Jussel s.n.*, Aug. 1921 (UC-JEP). *Stanislaus Co.*: Modesto, *Hoover 118*, Oct. 20, 1934 (UC, US).

MEXICO, SONORA: Guayamas, *Jones 27568*, Nov. 6, 1930 (NY, UC). SINALOA: Labradas, *Ferris and Mexia 5229*, Sept. 21, 1925 (GH). BAJA: Loreto, *Jones 27558*, Oct. 16, 1930 (GH, MO, NY, UC, US).

10. SUAEDA CALIFORNICA Wats., Proc. Amer. Acad. Arts Sci. 9: 89. 1874.
Dondia californica (Wats.) Heller, Cat. N. Amer. Pl. 3. 1898.

Stout, densely leafy, shrubby perennial, 2-8 dm. high; leaves deciduous

below, leaving prominent knobby leaf bases; branches ascending, stout, but herbaceous; leaves subterete, 1.5-3.5 cm. long, acute, lanceolate, little reduced in the inflorescence; flowers 1 or 2 per axil, 2.0-3.0 mm. wide; calyx deeply cleft, rounded on back, cucullate; seed 1.5-2.0 mm. broad, shining black.

Type: San Pablo Landing, California, *Bolander 412*, May 1865 (GH!).

California sea-blite.

Occurs in salt marshes along the Pacific Coast, San Francisco Bay, California to Lower California, Mexico. Plants mature July to October.

SPECIMENS EXAMINED: UNITED STATES, CALIFORNIA: *Alameda Co.*: Bay Farm I., *Davy s.n.*, Sept. 24, 1898 (UC). *Sonora Co.*: San Pablo Landing, *Bolander 412*, May 1865 (GH, NY, US). *San Luis Obispo*: sea cliffs, *Ferris and Ferris 7670*, April 16, 1929 (UC). *Santa Cruz Co.*: Anacapa I., *Clokey 4921*, June 4, 1930 (NY, UC). *Santa Barbara Co.*: Santa Cruz I., *Hoffman 548*, Sept. 21, 1930 (F). *Ventura Co.*: Ventura R., *Pollard s.n.*, Feb. 10, 1952 (TEX). *Los Angeles Co.*: Topango Canyon, *St. John 334*, Feb. 15, 1933 (UC). *Orange Co.*: Laguna Beach, *Munz 7320*, April 1, 1923 (NY, UC). *San Diego Co.*: San Diego Bay, *Gander 5519*, May 7, 1938 (UC).

MEXICO, BAJA: Hassler Cove, San Martin I., *Moran 3062*, May 5, 1948 (UC).

11. SUAEDA CALIFORNICA var. TAXIFOLIA (Standley) Munz, Calif. Fl. 384. 1959.

Suaeda californica var. *pubescens* Jepson, Fl. Calif. 447. 1914, in part.

Dondia taxifolia Standley, N. Amer. Fl. 21: 91. 1916.

Suaeda taxifolia (Standley) Standley, Publ. Field Mus. Nat. Hist. Bot. Ser. 8: 10. 1930.

Much-branched suffrutescent perennial, densely tomentulose or short-villous throughout; branches very stout, 2-10 dm. long, densely leafy; leaves narrowly linear, 1.0-3.0 cm. long, acute to acuminate, terete, those of the inflorescence crowded and little reduced (exceeding flower clusters), leaving prominent knobby leaf bases; flowers 1-4 per axil, 2.5-3.0 mm. broad; calyx cucullate, densely pubescent; seed 1.5-2.0 mm. broad, black.

Type: From salt marshes, Playa del Rey, Los Angeles Co., Calif., *LeRoy Abrams 2490*, June 10, 1902 (US #614215! Isotype NY!).

Woolly sea-blite.

Occurs in salt marshes along coast of California, Santa Barbara Co. to Baja California, Mexico.

SPECIMENS EXAMINED: UNITED STATES, CALIFORNIA: *Santa Barbara Co.*: Santa Cruz I., *Hoffmann 546*, Sept. 21, 1930 (F). *Kern Co.*: Rosamond, *Davy 2264b*, May 9, 1896 (UC). *Ventura Co.*: beach, 8 mi. n. of Ventura, *Munz 12922*, Sept. 10, 1932 (A F, MO, MU, UC). *Los Angeles Co.*: Ballast Point, Santa Catalina I., *Nuttall 805*, Aug. 21, 1920 (F, MO). *San Diego Co.*: beach at Del Mar, *Peebles 315*, Aug. 29, 1930 (A). *Orange Co.*: Santa Anas River bridge, Newport Beach, *Keller s.n.*, Nov. 26, 1937 (GH, UC).

MEXICO, BAJA: Laguna Mormona, *Johnson 130*, March 25, 1973 (DAV). San Martin I., *Howell 10716*, Aug. 19, 1932 (F, MO, NY, UC, US).

12. SUAEDA CALIFORNICA var. PUBESCENS Jepson, Fl. Calif. pt. IV: 447. 1914.
Dondia brevifolia Standley, N. Amer. Fl. 21: 92. 1916, not *Suaeda brevifolia* Phil. 1895. (Type: Newport, Calif., *Davidson 1779*, Sept. 1907 US #692799!).
Suaeda brevifolia (Standley) Eastwood, Proc. Calif. Acad. Sci. Ser. IV. 18(14): 479. 1929.
Suaeda brachyphylla Standley, Publ. Field Mus. Nat. Hist. Bot. Ser. 8: 10. 1930, (*nom nov.* for *D. brevifolia* Standley) not Phil. 1895.
Suaeda taxifolia ssp. *brevifolia* Abrams, Fl. Pac. States 2: 96. 1944.

Leaves short (0.3-0.8 cm.), obtuse to rounded at apex, with persistent knobby leaf bases; flowers smaller than those of the typical species (1.0-1.5 mm. broad); entire plant covered with very short, dense pubescence.

Type: Newport, Calif., *Davidson 1779*, Sept. 1907 (US #692799!).

Occurs in salt marshes along the coast of California, Sonoran Zone, Santa Barbara Co. and south into Baja and Lower California, Mexico, and Sinaloa, Mexico.

SPECIMENS EXAMINED: UNITED STATES, CALIFORNIA: *Orange Co.*: Newport Beach, *Davidson 1779*, Sept. 1907 (US). *Los Angeles Co.*: Santa Monica, *Hasse s.n.*, Aug. 19, 1889 (NY).
MEXICO, BAJA: Magdalena Bay, *Mason 1910*, May 29, 1925 (GH). SONORA: Puerto Libertad, *Wiggins 6073*, Oct. 25, 1932 (US). SINALOA: Cerros de Navachiste, *Gentry 14358*, Sept. 26, 1954 (US).

13. SUAEDA PALMERI (Standley) Standley, Publ. Field Mus. Nat. Hist. Bot. Ser. 8: 10. 1930.
Dondia palmeri Standley, N. Amer. Fl. 21: 91. 1916.

Glaucous, much branched perennial, suffrutescent; branches stout, ascending or somewhat spreading, mostly simple, densely white-tomentulose when young, often glabrate in age; leaves terete, 0.3-0.7 cm. long, 1.5-2.0 mm. thick, rounded at apex, narrowed at base, white-tomentulose when young, spreading, those of the inflorescence little reduced; flowers globose-obovoid, 1.5-2.0 mm. broad, 1 or 2 per axil; bracts rounded or obtuse at apex; calyx glaucous, glabrous or nearly so, cleft to the middle or lower, the lobes obtuse, rounded on back, cucullate, fleshy; seed usually horizontal, 1.5 mm. broad, black; styles 3, 'feathery'.

Type: Near Parras, Coahuila, Mexico, *E. Palmer 1168*, June 1880 (US #48315!).

Occurs in north central Mexico.

SPECIMENS EXAMINED: MEXICO, COAHUILA: 4 mi. w. of Cuatro Cienegas, *Johnston 7138*, Aug. 24, 1938 (GH, TEX). ZACATECAS: Concepcion del Oro, *Henrickson 14370*, Sept. 26, 1974 (CSULA).

14. SUAEDA SUFFRUTESCENS Wats., Proc. Amer. Acad. Arts Sci. 9: 88. 1874.
Dondia suffrutescens (Wats.) Heller, Cat. N. Amer. Pl. 3. 1898.

Much branched suffrutescent perennial 3-10 dm. high, copiously tomen-

tulose throughout, the pubescence loose and spreading; branches ascending, paniculately branched; leaves terete, mostly 0.5-1.3 cm. long, much reduced in the inflorescence, all acute, not crowded; flowers 1.0-1.5 mm. broad, 1-6 (-9) clustered in axils, crowded in dense spikes; calyx cleft to below middle, the lobes obtuse, relatively thin, cucullate, densely short pubescent as the leaves and stems; seed 0.7-1.0 mm. broad, black.

Lectotype (selected by Lundell, 1969): From the Rio Grande, *Maj. Wm. H. Emory s.n.*, Oct. 6, 1846 (NY!).

Desert seepweed.

Occurs in alkaline gypseous plains and valleys, western Texas, New Mexico, Oklahoma, Arizona, south into northern Mexico.

SPECIMENS EXAMINED: UNITED STATES, OKLAHOMA: *Major Co.*: Orienta, *Waterfall 7544*, July 11, 1947 (MO, NY, TEX). *Tillman Co.*: Hollister, *Waterfall 7296*, June 27, 1947 (MO, TEX). TEXAS: *Crane Co.*: Buena Vista, *Warnock 15608*, July 13, 1957 (TEX). *Pecos Co.*: Ft. Stockton, *Mears 1546*, May 28, 1967 (TEX). *Reeves Co.*: Pecos to Barstow, *Tharp and Gimbride 51-994*, July 7, 1951 (TEX). *Culberson Co.*: gypsum soil, east of Daugherty, *Waterfall 5189*, July 20, 1943 (GH, MO, NY). *Hudspeth Co.*: Ft. Quitman, *Cory 31045*, Oct. 24, 1938 (GH). *El Paso Co.*: El Paso, corner of Country Club Rd. and Montoya, *Blackwell 2329*, July 14, 1976 (MU). *Jeff Davis Co.*: Chispa, *Waterfall 5319*, July 26, 1943 (F, GH, MO, NY). *Presidio Co.*: along Rio Grande R., Porvenir, *York 48249*, July 7, 1948 (TEX). *Brewster Co.*: Lajitas, *Warnock 953*, July 17, 1937 (GH, TEX, US). *Ward Co.*: east of Pecos, *Waterfall 5504*, Aug. 6, 1943 (MO, NY). NEW MEXICO: *Chaves Co.*: Roswell, *Waterfall 4314*, Aug. 23, 1942 (GH). *Eddy Co.*: Carlsbad, *Standley 40337*, Aug. 12, 1924 (US). *Lincoln Co.*: White Mts., *Wooton 191*, July 22, 1897 (GH, MO, NY, UC, US). *Dona Ana Co.*: sandy bank at end of Camino Real just beyond El Paso city limits, *Blackwell 2334*, July 14, 1976 (MU). *Otero Co.*: White Sands, Alamogordo, *Fisher 54*, Aug. 6, 1931 (F). *Catron Co.*: Bat Cave Wells, *Smith 63*, July 2, 1948 (GH). ARIZONA: *Navajo Co.*: Holbrook, *Zuck s.n.*, July 10, 1897 (NY, US).

MEXICO, COAHUILA: Laguna del Coyote, *Henrickson 14269a*, Sept. 22, 1974 (CSULA). Laguna de Leche, *Johnston 8629*, Aug. 30, 1941 (GH, MO). CHIHUAHUA: Rio Grande, Paso del Norte, *Pringle 1997*, Sept. 9, 1888 (F, MO, NY, UC, US).

15. SUAEDA SUFFRUTESCENS var. DETONSA Johnston, Jour. Arnold Arb. 24: 230. 1943.

Suaeda nigrescens Johnston, Jour. Arnold Arb. 24: 228-229. 1943. (Type: from La Ventura, Coahuila, Mexico, *Johnston 7650*, Sept. 12, 1938. GH!).

Suaeda nigrescens var. *glabra* Johnston, Jour. Arnold Arb. 24: 228-229. 1943. (Type: from Ft. Quitman, Hudspeth Co., Texas, *Waterfall 3993a*, Aug. 18, 1942 GH!).

Leaves glabrous, green to glaucous, 0.3-1.3 cm. long, obtuse to acute tips; stems more or less pubescent, the leaves and calyx usually glabrous; other characters like typical *S. suffrutescens*.

Type: From 3 mi. west of Cuatro Cienegas, saline flats, loosely and widely branched, 1-5 ft. tall, frequently supported by other bushes, *Johnston 7128*, Aug. 24-26, 1938 (GH!).

Occurs in saline gypseous soils in trans-Pecos Texas, along the Rio Grande and Pecos valleys in adjacent New Mexico and south into southern Chihuahua and Coahuila, Mexico.

DISCUSSION: It is difficult to distinguish between this variety and specimens identified as *S. nigrescens* and its variety *glabra,* since leaf characters, inflorescence, branching patterns and distribution are very similar. There is some difference in degree of stem pubescence, and it may be shown later that *S. nigrescens* and *S. nigrescens* var. *glabra* are distinct from *S. suffrutescens* var. *detonsa* genetically. Until these differences, if they exist, can be shown taxonomically, doubtful specimens will be placed under *S. suffrutescens* var. *detonsa.* The flowers are also more densely clustered than on typical *S. torreyana,* with which members of this variety might also be confused.

SPECIMENS EXAMINED: UNITED STATES, TEXAS: *Gonzales Co.*: 50 mi. e. of San Antonio, salt flats near Pilgrim, *Cory 19213*, Aug. 23, 1936 (GH). *Brewster Co.*: Tornillo Creek, Hot Springs, *Sperry 1637*, Mar. 26, 1939 (GH). *Andrews Co.*: Shafter L., *Tharp s.n.*, July 10, 1941 (TEX). *Hudspeth Co.*: Rio Grande, near Ft. Quitman, *Waterfall 3993a*, Aug. 18, 1942 (GH). NEW MEXICO: *Otero Co.*: White Sands, *Archer 7334*, Oct. 19, 1938 (GH). *Chaves Co.*: Hagerman, *Benke 5023*, Apr. 27, 1923 (GH).

MEXICO, COAHUILA: Monclova to Cuatro Cienegas, *Johnston 7128*, Aug. 24-26, 1938 (GH). SAN LUIS POTOSI: alkaline flat, San Miguel, *Johnston 7619*, Sept. 11-12, 1938 (GH). CHIHUAHUA: Meoqui, *LeSeuer 197*, Aug. 24, 1935 (GH, TEX). ZACATECAS: west of Guadalupe Carceron, *Johnston, Wendt and Chiang 11597*, July 3, 1973 (CSULA).

16. SUAEDA MEXICANA (Standley) Standley, Publ. Field Mus. Nat. Hist. Bot. Ser. 4: 203. 1929.
Dondia mexicana Standley, N. Amer. Fl. 21: 89. 1916.

Annual herbs, glabrous, 3-12 dm. tall, mostly branched at the base; branches numerous, ascending or nearly erect, elongate; leaves numerous but not crowded, linear, semiterete, the lower leaves 1.2-4.0 cm. long, 1.2 mm. broad, acuminate or attenuate, those of the inflorescence shorter; inflorescence paniculately branched, the branches erect; flowers crowded in the axils and forming spikes 4-5 mm. thick; calyx deeply cleft, the lobes rounded, becoming more enlarged at the base, strongly cucullate-carinate in age, the fruiting calyx 3 mm. broad; stamens exserted at maturity; seed ca. 0.8 mm. broad, horizontal, shining dark brownish-red; styles 2, 'feathery'.

Type: From San Luis Potosi, Hacienda Angostura, alkaline plain near San Bartolo Station, Mexico, *C. G. Pringle 3788*, July 15, 1891 (US #48314!).

Mexican seepweed.

Occurs in western Texas, south into San Luis Potosi, Mexico.

SPECIMENS EXAMINED: MEXICO, COAHUILA: 3 mi. west of Cuatro Cienegas, *Henrickson 14292*, Sept. 23, 1974 (CSULA). SAN LUIS POTOSI: Las Tables, *Pennell 18047*, April 9-10, 1934 (GH, US).

17. SUAEDA JACOENSIS Johnston, Jour. Arnold Arb. 24: 228. 1943.

Annual or perennial succulent, 1-3 dm. tall, glabrous, pale green, branching from small caudex crowning a coarse persisting root; stems slender, somewhat purplish verrucose (warty), numerous, erect, rigid, simple or sparsely branched; leaves linear, 1-2 cm. long, ca. 1.2 mm. wide, compressed succulent, the apex obtuse, apiculate; the lower leaves conspicuously opposite, the others alternate; flowers axillary, subsessile, clusters distant (usually 2-3 mm. apart), subspicate; bracts hyaline, triangular or oblong, dentate or inconspicuously lacerate-dentate; calyx in fruit irregular crispate and carinate, some almost appendaged with corky tubercles, or with a vertical as well as a transverse basal wing that may be corky-thickened and prolonged off obliquely at the base; seed horizontal, 1.1-1.3 mm. broad, shiny black-brown; styles 2, 'feathery'.

Type: From salt flats at southeastern end of Laguna de Jaco, common, western Coahuila, Mexico, *Stewart and Johnston 1975*, Oct. 4-5, 1941 (GH!).

Apparently an endemic species on flats at southeastern end of Laguna de Jaco, Coahuila, Mexico, where the soil is strongly saline and gypsiferous.

SPECIMENS EXAMINED: MEXICO, COAHUILA: Laguna de Jaco, *Henrickson 14215*, Sept. 20-21, 1974 (CSULA).

18. SUAEDA TAMPICENSIS (Standley) Standley, Publ. Field Mus. Nat. Hist. Bot. Ser. 8: 10. 1930.
Dondia tampicensis Standley, N. Amer. Fl. 21: 91. 1916.

Green, much branched perennial, the branches stout, ascending or decumbent, suffrutescent, copiously short-villous, paniculately branched; leaves terete, 7-15 mm. long, acute or acuminate, spreading, those of the inflorescence little reduced; flowers 1.5-2.0 mm. broad, globose-obovoid, 1-5 per axil; bractlets acuminate; calyx glabrous or nearly so, cleft to below the middle, the lobes rounded at the apex, fleshy, cucullate; seed usually horizontal, 1 mm. broad, black, shiny.

Type: Along the coast near La Barra, Tamaulipas, 8 km. east of Tampico, Mexico, *Edward Palmer 262*, Feb. 1910 (US #463200!).

Occurs in coastal sandy areas, southern Texas and eastern coast of Mexico, also in the West Indies.

SPECIMENS EXAMINED: UNITED STATES, TEXAS: Cameron Co.: 11 mi. east of Brownsville, *Correll and Johnston 17957*, July 13, 1957 (A). *Starr Co.*: Rio Grande City, *Tharp 5783*, June 16, 1928 (TEX, US). *Kenedy Co.*: Padre I., *Tharp 5567*, June 1922 (TEX).

MEXICO, TAMAULIPAS: Matamoras, *Wooton s.n.*, June 29, 1919 (US).

DOMINICAN REPUBLIC: Isla de Cabritos, Laguna de Enriquillo, *Ekman 9860*, April 16, 1928 (GH, US).

HAITI: Bocazelle, Artibonite Plains, *Sweet s.n.*, 1925 (NY, US).

19. SUAEDA CONFERTA (Small) Johnston, Jour. Arnold Arb. 24: 230. 1943.
Dondia conferta Small, Bull. N. Y. Bot. Gard. 1: 280. 1899.

Lerchea conferta (Small) K. Schumann in Just., Bot. Jahrb. 27(1): 482 1901.

Dondia insularis Britton, Bull. N. Y. Bot. Gard. 4: 138. 1906. (Type: from Grand Turk I., Bahamas, *Nash and Taylor 3873*, Aug. 27-Sept. 1, 1905, US #847951!).

Perennial suffrutescent shrub, stems erect or ascending, 4-10 dm. long, the branches prostrate or spreading, forming dense tufts, very brittle, glabrous; leaves numerous, glabrous, the leaf-blades fleshy and blue-gray (glaucous), mostly less than 1 cm. long, 1-2 mm. broad, oblong; flowers solitary or clustered in the axils of the rather approximate leaves, especially numerous on the branchlets; calyx lobes obtuse, cucullate, seed about 1 mm. broad, black.

Type: From coastal flats, Corpus Christi, *A. A. Heller 1827*, June 2-6, 1894 (US #213983!).

Along the Atlantic Coast of Texas and Mexico, also in the West Indies.

SPECIMENS EXAMINED: UNITED STATES, TEXAS: *Nueces Co.*: Corpus Christi, *Young s.n.*, Mar. 14, 1914 (MO, TEX). *San Patricio Co.*: Ingleside, *Cory 45326*, July 25, 1944 (GH). *Cameron Co.*: Yucca I., *Johnston 542359*, Dec. 23, 1954 (TEX). *Hidalgo Co.*: *Clover 1189*, May 24, 1933. *Kenedy Co.*: Padre I., *Cutak 29*, July 26, 1938 (MO). *Aransas* Co.: Rockport, *Reverchon 1788*, July 1893 (MO). *Kleberg Co.*: Laguna Madre, King Ranch, *Johnston s.n.*, July 3, 1953 (TEX).

HAITI: Plains de la Artibonite, *Ekman H3342*, Feb. 27, 1925 (GH).

DOMINICAN REPUBLIC: Santo Domingo, Isla de Bauritas, *Ekman H9860*, Apr. 16, 1928 (A).

BAHAMAS: Grand Turk I., *Nash and Taylor 3873*, Aug. 27, 1905 (F, US).

DOUBTFUL AND EXCLUDED SPECIES

1. *Suaeda duripes* Johnston, Jour. Arnold Arb. 24: 231. 1943. (Type: from Texas, Pecos River, salt soil, *Geo. Thurber 114*, Nov. 1850 GH!). = ? *S. suffrutescens* var. *detonsa*. Known only from the type collection, said by Johnston (1943) to be endemic to Reeves and Pecos Cos., Texas.
2. *Suaeda fernaldii* (Standley) Standley, Publ. Field Mus. Nat. Hist. Bot. Ser. 4: 203. 1929. (Type: from red sandstone alluvium near mouth of Salmon River, Truro, Colchester Co., Nova Scotia, *Fernald and Wiegand 3324*, Sept. 11, 1910 GH!, fragment and photo US!, photo NY!), as *Dondia fernaldii* Standley, N. Amer. Fl. 21: 88. 1916. Known only from the type collection. It may be a local variant of *S. americana*.

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TAXONOMY AND DISTRIBUTION OF *GENTIANA* (GENTIANACEAE) IN MEXICO AND CENTRAL AMERICA. I. SECT. *PNEUMONANTHE*[1]

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This paper is the first of two that together will constitute a taxonomic monograph on *Gentiana* L. in Mexico and Central America. No such monograph has previously been published, nor does any modern floristic work provide for identification of all these species.

Following Gilg's (1895) treatment of the Gentianaceae, as modified by Wagenitz (1964), *Gentiana* is included in the tribe Gentianeae, subtribe Gentianinae. Tribal and subtribal traits have been given by these authors.

The circumscription of *Gentiana* accepted here follows that in publications on the Gentianaceae by Smith (1936; 1967), Fabris (1960), Gillett (1963), Toyokuni (1963), Mason & Iltis (1966), Nilsson (1967), Tutin (1972), and Weaver & Rüdenberg (1975). As thus delimited, *Gentiana* is distinguished from other genera in the Gentianinae by the following combination of characters: calcium oxalate crystals in the leaves (except in sect. *Calathianae* Froel.); a continuous intracalycular membrane (except in at least part of sect. *Chondrophyllae* Bunge); three primary veins per petal; appendages, or plicae (discussed below), between the primary divisions of the corolla (except in *G. lutea* L.); basifixed anthers; naked nectar-secreting glands borne on the gynophore; septicidal, capsular fruits; no fringes, scales, or nectaries on the interior surface of the corolla; and no marginal fringes on the corolla lobes. This circumscription of *Gentiana* is narrower than that in most North American floras in that it excludes those North American species included by Gillett (1957) in *Gentianella* Moench. It is, however, more inclusive than that of Löve & Löve (1975), who restricted *Gentiana* to the five European species treated by Tutin (1972) as sect. *Gentiana*. In this restricted generic concept, in which groups differing in basic chromosome number are treated as distinct genera, the species discussed in the present paper would be placed in the genus *Tretorhiza* Adans.

Although a complete generic description of *Gentiana* is not included here, it does appear to be necessary to discuss certain features of the corolla because of their unusual nature and because of the diversity of terms which have been used in describing them. The corolla of *Gentiana* consists of five (occasionally four or six, rarely more) united petals, each of which terminates in a corolla lobe. Within the corolla tube, each of the primary divisions

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is separated from the next by a triangular segment of corolla tissue, which is invaginated in bud and to some extent at anthesis, and which is vascularized only distally by branches from the lateral veins of the two adjacent petals. These structures are called "appendages" in this paper, following such works as the *Flora Europaea* (Tutin, 1972); in some other publications on *Gentiana*, they have been termed "plicae" or "plaits."

The corollas of *Gentiana*, dextrorsely contorted in bud, emerge from the calyces long before anthesis. Until the corolla opens, part of each lobe is overlapped by part of the next lobe clockwise, except in a few species with greatly reduced lobes. The margin of the corolla lobe exposed in bud is termed the "outer margin" in this paper, and the other margin is termed the "inner margin." This use of "outer" and "inner" is to be distinguished from references to the exterior and interior (i.e., abaxial and adaxial) surfaces of the corolla.

Kusnezow's (1894) monograph of *Gentiana* "subgenus *Eugentiana*" and his (1895) treatment of *Gentiana* in Engler & Prantl's *Die natürlichen Pflanzenfamilien* provide the generally accepted basis for the division of *Gentiana* into sections, although some later authors have proposed refinements. Kusnezow's "subgenus *Engentiana*" is equivalent to *Gentiana* as the genus is circumscribed in this paper and in the recent publications cited above.

Only two sections of *Gentiana* are represented in Mexico and Central America, viz., sect. *Pneumonanthe* Gaudin and sect. *Chondrophyllae* Bunge. This paper deals with the taxonomy and distribution of sect. *Pneumonanthe*.

Key to the Sections of *Gentiana* in Mexico and Central America

1a. Small plants, usually less than 8 cm tall, with slender, fibrous roots; leaves less than 1 cm long; flowers less than 2 cm in length or diameter; free portions of corolla appendages nearly symmetrical, 2/3 to fully as long as lobes; gynophore slender, elongating in fruit so that the ovary is largely or completely exserted from the marcescent corolla. . . . . sect. *Chondrophyllae*.

1b. Plants usually well over 8 cm tall; tap root large and persistent, or replaced by several stout, fleshy secondary roots; larger leaves over 2 cm long; flowers over 2 cm long; free portions of corolla appendages more or less oblique, much exceeded by lobes (in Mexican and Central American species); gynophore variable, but not elongating sufficiently to exsert the entire ovary from the marcescent corolla. sect. *Pneumonanthe*.

GENTIANA [sect.] PNEUMONANTHE Gaudin, Fl. Helv. 2:269. 1828. Type species (Art. 22, ICBN): *Gentiana pneumonanthe* L.

Pneumonanthe Gled. (pro gen.), Syst. Pl. p. 238. 1764. Type species (only species definitely included): *Gentiana pneumonanthe* L., as *Pneumonanthe* [sp.].

Gentiana . . . *Pneumonanthe* Link (sine ord.), Enumeratio Pl. Hort. Reg. 1:258. 1821.

Gentiana subgenus *Pneumonanthe* Raf., Med. Fl. 1:208. 1828. Type species (Art. 22, ICBN): *Gentiana pneumonanthe* L.

Xolemia Raf. (pro gen.), Fl. Tellur. 3:22. "1836" [1837]. Lectotype species (hoc loc.): *Gentiana saponaria* L.

Xolemia subgenus *Cutlera* Raf., Fl. Tellur. 3:23. "1836" [1837]. Lectotype species (hoc loc.): *Gentiana catesbaei* Walt., as *Xolemia catesbei* [sic] (Walt.) Raf.

Gentiana sect. *Cyane* Griseb. in Hook., Fl. Bor.-Amer. 2:54. "1840" [1837]. Type species (Art. 7, ICBN; see Pringle, in press): *Gentiana pneumonanthe* L.

Perennials. Roots either several-many, thick, fleshy, and individually usually of short duration, or, in other species, consisting of a stout, persistent tap root and several smaller secondary roots. Rhizomes short and erect (geocorms). Stems 1-several, terete, generally over 5 cm long and in some species often over 1 m, ascending to erect, or in some species commonly decumbent at base, usually unbranched or with short, peduncle-like branches only. Rosettes of leaves absent except in seedlings. Leaf and calyx-lobe margins entire, minutely denticulate, or ciliolate, in most species neither cartilaginous nor scarious. Flowers erect (or somewhat declined in *G. caliculata* Lex.), 2.5-7.5 cm long. Calyx tubes either 15-nerved or 10-nerved through fusion of lateral sepal veins, cylindrical to vase-shaped, or in some species either occasionally or regularly cleft and spathelike. Intracalycular membrane generally well developed. Corollas ranging from completely closed to wide open at anthesis, open corollas closing at night and in cloudy weather but not thigmonastic. Corolla tubes cylindric to funnelform, vase-shaped, or urceolate. Corolla lobes shorter than tubes, deltoid to ovate-elliptic, or, in *G. andrewsii* Griseb., reduced to mucros. Free portions of corolla appendages usually well developed, basically bifid, usually oblique, with the sinus next to outer margin of each corolla lobe being deeper than the one next to inner margin, and the appendage segment next to the shallower sinus being narrower, but sometimes longer, than the other segment; in some species with the segment next to the inner corolla-lobe margin greatly reduced and deflexed, appearing as a projection from the lobe, or obsolete. Free portions of appendages in a few species symmetrical but well developed, in a few other species reduced to 2 small teeth or nearly obsolete. Summits of appendages (when well developed) ranging from subentire, erose, or minutely serrate (in species with one segment reduced) to shallowly to deeply laciniate, or shallowly fimbriate to deeply setose-fimbriate. Corollas of most species predominantly dark to light blue or violet-blue, with occasional forms having lilac, rose-violet, or white corollas; corollas of some species regularly violet, white, yellowish-white, or greenish-white; those of *G. caliculata* Lex. and *G. mirandae* Paray red. Darker stripes usually present on the interior surface of the tube, between primary veins of petals. Stamens equal, with straight filaments. Anthers connate (in all species with closed or nearly closed corollas, and in some species with open corollas) or free. Pollen grains oblate-spheroid to prolate, with sexine distinctly and often coarsely striate. Ovary compressed lance-ovoid, gradually

tapering into a short style, the style not sharply demarcated at anthesis and not spirally twisted (except tardily in *G. caliculata*). Stigmatic lobes linguliform or in a few species more slender, recurving. Gynophore relatively short and stout, usually 0.5-1.5 cm long and 1.5-2 mm thick at anthesis (longer and more slender in *G. mirandae*), elongating somewhat in fruit but not so as to elevate the entire ovary above the marcescent corolla. Carpels each with 1 dorsal and 6 ventral vascular bundles. Ovules distributed all over interior surface of ovary except in the immediate vicinity of sutures. Seeds with an obscurely to prominently reticulate testa, the testa in most species being expanded into a membranous wing partially or completely surrounding body of seed. $2n = 26$ in all taxa for which chromosome counts have been published. Sectional description compiled from Kusnezow (1895), Lindsey (1940), Toyokuni (1963), Nilsson (1967), standard references to published chromosome counts, and my own observations.

The foregoing description does not provide for *G. asclepiadea* L. because various lines of evidence suggest that this species may be misplaced in sect. *Pneumonanthe*. The generic name *Dasystephana* Adans., typified by *G. asclepiadea*, has therefore been omitted from the synonymy, along with the illegitimate modification *Dasistepha* Raf. *Gentiana newberryi* A. Gray and *G. tiogana* Heller have likewise been excluded from consideration, since their inclusion in this section also appears to be questionable.

The generic names *Ciminalis* Adans., *Diploma* Raf., *Ericoila* Borkh. (nom. illeg., altered to *Ericala* by some authors), *Hippion* F.W. Schmidt (nom. illeg.), and *Tretorhiza* Adans. emend. Löve & Löve are typified by species in other sections of *Gentiana*. Therefore, they have been excluded from the synonymy of sect. *Pneumonanthe*, although some authors have transferred species in sect. *Pneumonanthe* to these "genera."

Considerable variation exists in the orthography of the name of this section and in the authorship to which it has been attributed. Reasons for citing Gaudin (1828) as the author of the name *Gentiana* sect. *Pneumonanthe* have been given previously (Pringle, in press).

The formal subdivision of sect. *Pneumonanthe*, which would require consideration of variation patterns throughout its range, is not within the scope of this paper. The Mexican and Central American species of this section can, however, be informally divided into two groups. The first group, comprising *G. bicuspidata*, *G. ovatiloba*, and *G. hooperi*, is characterized by irregular, unpaired branching, if any, and by ebracteolate flowers. The other group, which includes *G. spathacea*, *G. laevigata*, and *G. caliculata*, differs in having isocladous branching, if any, with the flowers being borne in symmetrical, usually condensed cymes, and in the presence of paired bracts subtending each flower. *Gentiana mirandae*, because of the paired bracts subtending the flowers, can also be included in the latter group, although its branching is not always strictly isocladous.

In its entirety, sect. *Pneumonanthe* comprises about 50 species, native to North America from Guatemala north to Alaska and Labrador; to most of

Europe, except for the warmer, lowland regions; and to much of Asia, including the Caucasus, the Himalaya, central and southern Soviet Asia, central, southern, and eastern China, and Japan. Throughout the range of this section, its representatives are largely confined to humid or subhumid, warm-temperate to boreal regions. Those native to tropical latitudes, including the Mexican and Guatemalan species, are restricted to high elevations.

In the present paper, references to the physiographic provinces in which *Gentiana* species occur follow Raisz (1964). References to vegetational zones in Mexico follow Leopold (1950) and Flores Mata et al. (1971). Most Mexican species of sect. *Pneumonanthe* occur in the coniferous forest (bosque de coníferas) of Flores Mata et al. Its lowest subdivision, the pine-oak forest (bosque de pino-encino) of both Leopold and Flores Mata et al., is extensive in Mexico, occupying much of the higher terrain in the Sierra Madre Occidental, Sierra Madre Oriental, Neovolcanic Plateau, and Sierra Madre del Sur. It was further subdivided by Leopold, with the pine-oak woodland probably being the most important subdivision as a habitat of species in sect. *Pneumonanthe*, although they also occur in openings in the pine forest. *Gentiana* species are also present in the vegetational zones at higher altitudes on the Neovolcanic Plateau, including the transitional pine-alder-fir forest of Leopold (ca. 2200 m to 2300-2600 m), the fir forest (bosque de oyamel) (up to 2900-3200 m), and the relatively open *Pinus hartwegii* Lindl. forest (bosque de pino), which extends to treeline about 3600 m. Treeless alpine meadows (zacatonales of Flores Mata et al.) on the highest mountains are the habitat of one species in sect. *Pneumonanthe*.

In the Sierra Madre del Sur and the Chiapas-Guatemala Highlands and along the eastern rim of the Neovolcanic Plateau, the cloud forest of Leopold—termed deciduous forest (bosque de caducifolio) by Flores Mata et al., although it includes some pines—prevails above 1500 m and constitutes the principal habitat of the representatives of sect. *Pneumonanthe* in these ranges. In the highest mountains, *Pinus rudis* Endl. reaches higher elevations than other tree species, forming open woodlands in which *Gentiana* is also present.

The vegetation and major physiographic features of Guatemala, the only Central American country in which sect. *Pneumonanthe* is represented, have been mapped by Steyermark (1950). Two physiographic regions in Guatemala are mentioned in the present paper, namely, the Sierra de los Cuchumatanes, which is a part of Los Altos of Raisz (1964), and the Sierra Madre of Guatemala, which is continuous with the Sierra de Chiapas of southern Mexico. *Gentiana* species occur in the temperate-cold upland forest of Steyermark (equivalent, within the context of the present study, to Leopold's cloud forest), and in the alpine zones.

Populations of *G. bicuspidata*, *G. hooperi*, *G. mirandae*, *G. ovatiloba*, and *G. spathacea* have been studied in the field. Also, specimens have been examined from the following herbaria (abbreviations from Holmgren & Keu-

ken, 1974): A, ASU, BH, CAN, CAS, COLO, CU, DS, DUKE, ENCB, F, GH, HAM, ILL, MEXU, MICH, MIN, MO, MSC, MU, NCU, NY, POM, RSA, TAES, TENN, TEX, UC, US, VT, WTU, and WVA. Only a representative selection of specimens has been cited for each species, except for the newly described *G. hooperi* and the rarely collected *G. mirandae*, for which all known collections are listed. A complete list of specimens examined has been placed in the Depository of Unpublished Data, National Science Library, Ottawa, Canada, from which copies can be obtained, as well as in the library of the Royal Botanical Gardens, Hamilton, Ontario.

The chromosome counts reported in this paper are the first for any Mexican species of *Gentiana*. For *G. bicuspidata* and *G. spathacea*, the voucher specimens cited are those from which seed was obtained in the field. Chromosome counts were obtained from the seedlings. Root tips were pretreated in a saturated solution of α-bromonaphthalene for 2.5 hr at 18-20°C, fixed in Farmer's fluid, and stained with acetocarmine. Root tips of *G. ovatiloba* were obtained from plants collected in the field and were immediately fixed in Farmer's fluid. The illustrations of chromosomes are tracings from photomicrographs.

Species concepts in the present work take into account the remarkable extent to which interfertility has persisted among morphologically diverse species in sect. *Pneumonanthe*. The frequency of natural interspecific hybridization in this section is correlated more closely with the similarity of the geographic and ecological ranges of the parental species than with morphological similarities. Consequently, the mere existence of intermediates cannot be accepted as a practical basis for the amalgamation or reduction in rank of two taxa that would otherwise be treated as two species. Species have been accepted at this rank if the great majority of specimens seen could definitely be identified as belonging to one species or the other, with any intermediates evidently representing exceptional local populations rather than true intergradation. Experience with sect. *Pneumonanthe* in Canada and the United States has indicated that species meeting this criterion, even if the differences between them are not great, are nevertheless likely to be more sharply defined than any of the more inclusive taxonomic units one might attempt to assemble.

Key to the Mexican and Central American Species of Sect. *Pneumonanthe*

1a. Corollas red; stamens exserted.

2a. Calyx lobes arcuate-recurved; corolla lobes reflexed; corolla appendages bifid, ca. 1 mm long; gynophore much shorter than ovary at anthesis. . . . . 6. *G. caliculata*

2b. Calyx and corolla lobes erect or nearly so; corolla appendages obliquely triangular, ca. 2 mm long; gynophore about as long as ovary at anthesis. . . . . 7. *G. mirandae*.

1b. Corollas blue, violet, or nearly white; stamens included.

3a. Branching, if any, irregular, the branches usually only one at a node; flowers solitary at ends of stems or branches, or in raceme-like in-

florescences, not individually subtended by small bracts; corolla tubes vase-shaped or broadly campanulate.

4a. Corolla lobes violet-blue, contrasting with the white appendages; calyx lobes linear-subulate, 2-5 mm long, noticeably shorter than tube; corolla tube slender below, flaring only in upper half. . . . . 3. *G. hooperi.*

4b. Corolla lobes and appendages concolorous, blue, violet, or nearly white; calyx lobes linear to ovate-elliptic, about as long as tube or longer; corolla tube flaring from near base.

5a. Leaves linear; upper internodes longer than middle and lower ones, often over 2 cm long; calyx lobes linear; corolla lobes more or less orbicular, apiculate; flowers solitary, each terminating an unbranched stem or a distinct branch usually over 1 cm long. . . . . 1. *G. bicuspidata.*

5b. Leaves elliptic, closely spaced throughout; calyx lobes elliptic to ovate; corolla lobes ovate, rounded at apex when fully expanded; flowers solitary or in rather dense racemes of 2-8, the peduncle-like branches usually less than 1 cm long. . . 2. *G. ovatiloba.*

3b. Branching, if any, isocladous; flowers clustered in compact cymes or heads, individually subtended by small bracts; corolla tubes cylindric to narrowly urceolate-campanulate.

6a. Leaves broadly lanceolate to ovate, with 3-7 prominent veins, neither falcate nor strongly conduplicate; calyx usually largely hyaline, deeply cleft, with minute lobes; corolla lobes elliptic, apiculate. . . . . 4. *G. spathacea.*

6b. Leaves linear to narrowly oblong, usually with only the midvein prominent, upper leaves usually conspicuously falcate and conduplicate; calyx usually green and uncleft, with lobes 2-7 mm long; corolla lobes deltoid-ovate, usually obtuse or rounded at the apex. . . . . 5. *G. laevigata.*

1. GENTIANA BICUSPIDATA (G. Don) Briq., Candollea 4:324. 1931. Fig. 1.

Pneumonanthe bicuspidata G. Don, Gen. Hist. 4:194. "1838" [1837]. Based on *Gentiana assurgens* Sessé & Mociño, ined. Lectotype (hoc loc.): MEXICO: no further locality data, *Mociño & Sessé s.n.*, no date, OXF, photos in HAM!; probable duplicates, *Sessé et al. 1368* (number assigned by curator at MA), no date, F!, MA, and (unnumbered) GH!

Gentiana assurgens Sessé & Mociño ex G. Don, Gen. Hist. 4:194. "1838" [1837], pro syn.

Gentiana adsurgens Cerv. ex Griseb. in Hook., Fl. Bor.-Amer. 2:57. "1845" [1837] (in ablative, "*adsurgente*"), nomen nudum; Cerv. ex Griseb., Gen. Sp. Gentianearum p. 286. "1839" [1838], with description. Type collection: *Sesse et al. 1368*, cited under *Pneumonanthe bicuspidata* G. Don, above.

Gentiana adsurgens [var.] β *uniflora* Kusn., Trudy S.-Peterburgsk. Obshch. Estestvoisp., Otd. Bot. 24(2):61. 1894. Syntypes: MEXICO: [Distrito

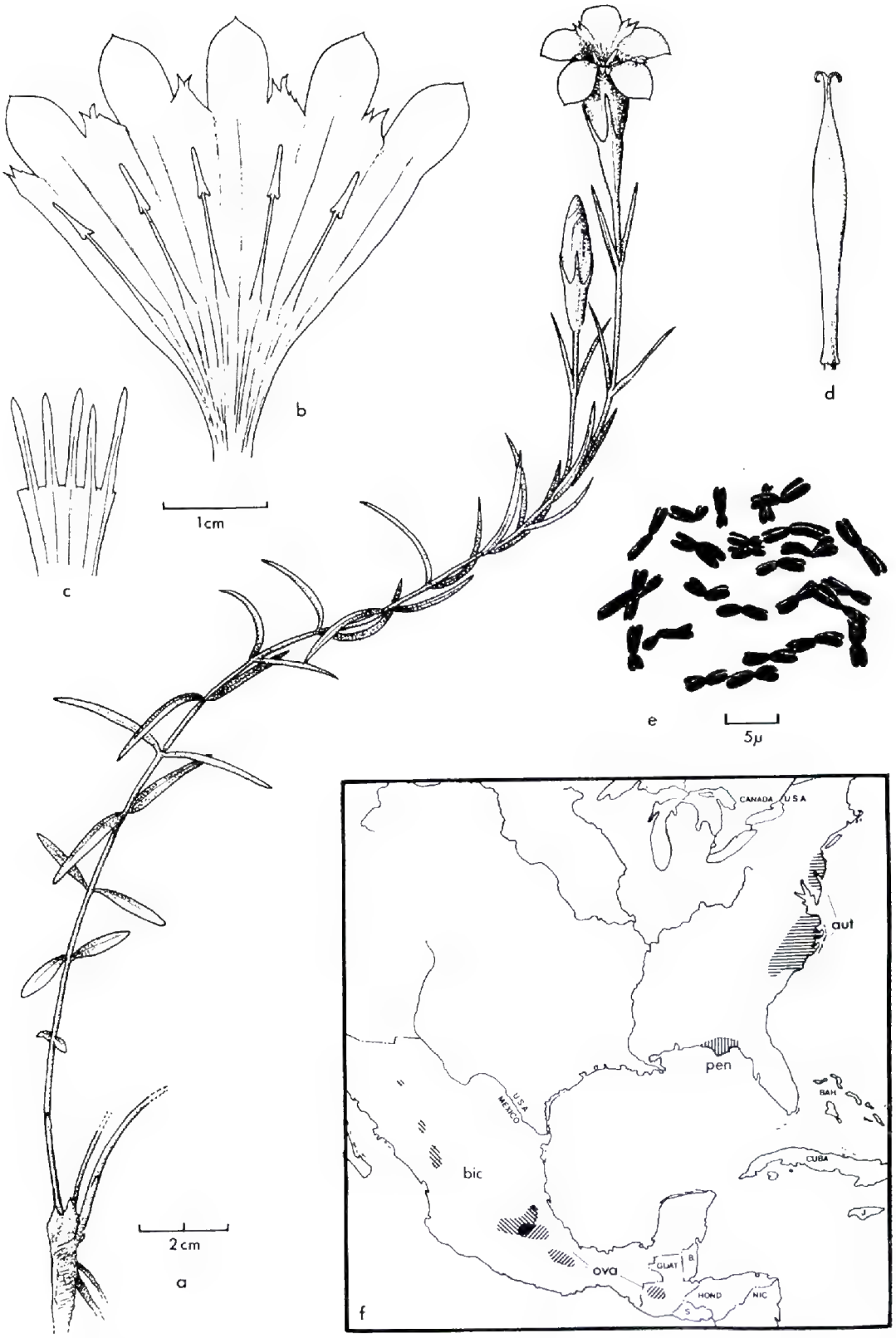

Fig. 1. *Gentiana bicuspidata*. a, flowering stem; b, interior surface of corolla, and c, exterior surface of calyx, slit longitudinally and pressed; d, pistil; e, somatic chromosomes; f, ranges of *G. autumnalis* (aut), *G. bicuspidata* (bic), *G. ovatiloba* (ova), and *G. pennelliana* (pen).

Federal]: Desierto Viejo, Valle de México, *Bourgeau 1123*, 17 Oct 1866, B (probably not extant), LE (uncited duplicates in GH!, MICH!, US!, and probably elsewhere; and MEXICO: no further locality data, *Ehrenberg s.n.*, B (probably not extant), LE (uncited duplicate in MEXU!).

Gentiana angusta M.E. Jones, Contr. W. Bot. 12:52. 1908. Probable type: MEXICO: Chihuahua: Mound Valley, Sierra Madre Mts., alt. 7000 ft, *Jones s.n.*, 18 Sep 1903, DS!

Tap root usually well developed and persistent, 0.8-1.5 cm in diameter at the summit and 0.5-1.5 dm long, often forked, or occasionally accompanied or replaced by 2-several subequal secondary roots. Stems usually 1-6, occasionally up to 12 or more, decumbent to suberect, 1-4 dm long, papillose-puberulent in lines below the leaf bases, otherwise glabrous, usually simple, occasionally with 1-4 branches. Leaves bright green, linear or lowest ones narrowly elliptic, longest near middle of stem, only moderately reduced above and below, except near soil level, upper internodes often appreciably longer than lower and middle ones. Upper leaves acute at apex, lower leaves obtuse, all tapering at base. Leaves mostly 1.5-5.5 cm long, upper ones usually 20-30 times as long as broad, occasionally broader, median ones 8-15 times as long as broad, lowest ones highly variable in proportions. Leaf margins minutely and shallowly denticulate, usually more or less revolute. Flowers solitary at ends of stems or branches, without involucres, the uppermost leaves usually well separated from base of flower. Calyx tube uncleft, 7-17 mm long, glabrous. Calyx lobes erect, linear to narrowly oblong, 5-10(-20) mm long, acute. Corolla 3-5.5 cm long, the tube funnelform, increasing gradually in diameter from the base upward. Corolla lobes spreading, elliptic or sometimes obovate, (5.5-)7-12 mm long, apices abruptly acuminate to rounded-apiculate, margins sparingly erose-serrate to subentire, sinus adjacent to outer edge of each lobe slightly deeper than the other. Free portions of corolla appendages 2-5 mm long, subequally bifid, primary divisions often further cleft, ultimate segments acuminate to attenuate. Lower ½-¾ of corolla tube pale, exterior surface of the petals proper suffused with bronze-purple, interior surface with purplish-blue stripes between the central and lateral veins of petals and with small purplish-blue spots elsewhere. Upper ¼-½ of corolla tube, lobes, and free portions of appendages pale to deep blue throughout, with the purplish suffusions on exterior surface extending to outer margins of lobes and a green suffusion extending to all but inner margin, and prominent yellowish-green spots on interior surface of the lower half of lobes and adjacent portions of tube. Stamen filaments becoming free a little below middle of corolla tube, free portions 7.5-10.5 mm long. Anthers ca. 5 mm long, not cohering. Fruits slightly to more than half exserted at anthesis. Seeds ca. 2 mm long, 0.9 mm wide, completely winged. $2n = 26$ (voucher specimen: MEXICO: Hidalgo: 4.8 km N of Agua Blanca Iturbide, *J.S. Pringle 1303a*, 28 Jan 1972, HAM).

Most populations of *G. bicuspidata* are in the Neovolcanic Plateau and in

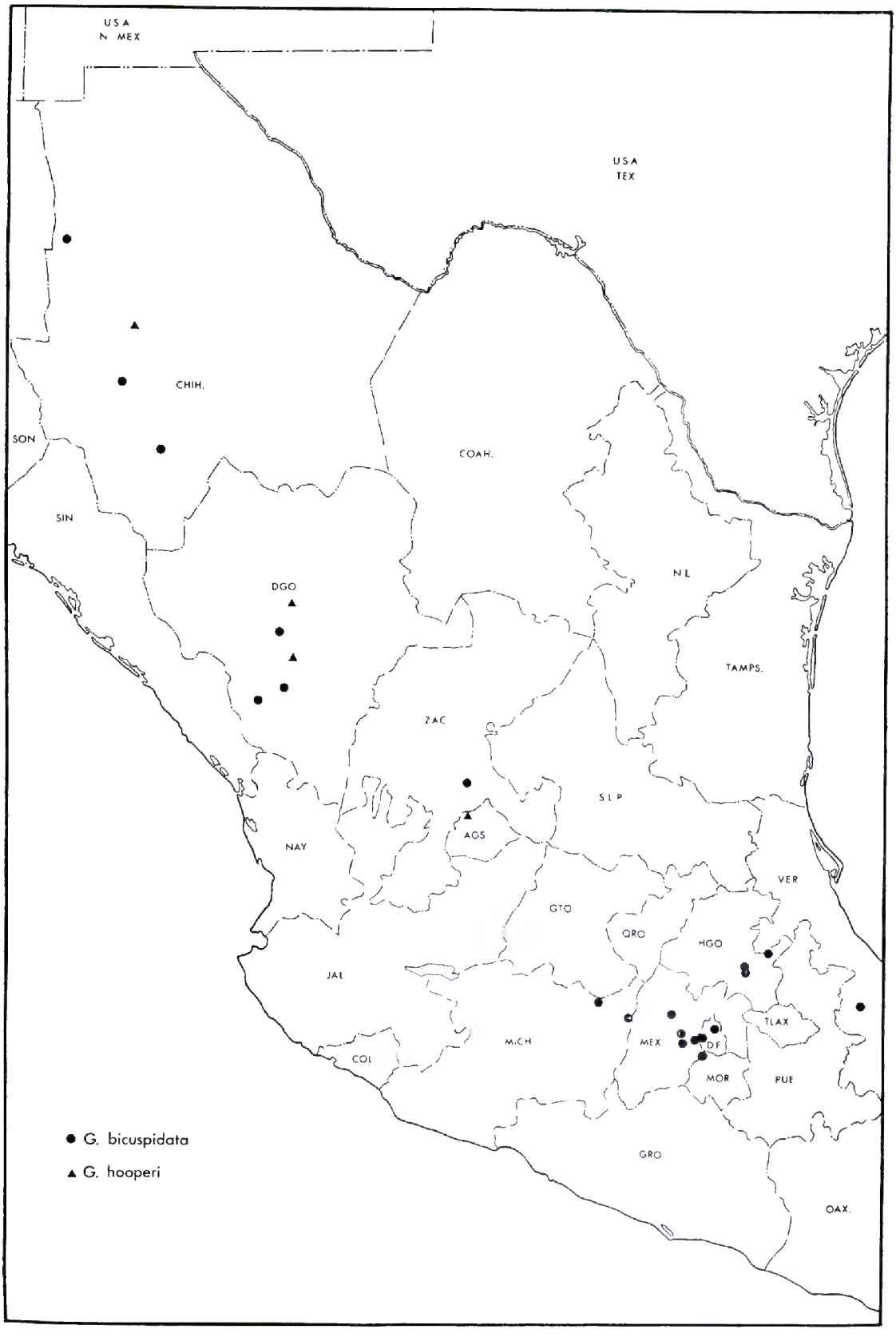

Fig. 2. Documented distribution of *Gentiana bicuspidata* and *G. hooperi*.

the adjacent southernmost portion of the Sierra Madre Oriental (Sierra de Pachuca), from Hidalgo west to northeastern Michoacán, with disjunct populations occurring in the Sierra Madre Occidental in Durango and southern Chihuahua (Fig. 2). Its usual habitat is a consistently moist meadow, often near a stream or pond, most frequently in the pine-alder-fir zone, sometimes in the fir forest zone, or, in its easternmost populations, in the northern outliers of the cloud forest. Specimens have been collected in flower from September through March.

Representative specimens examined:

MEXICO: Chihuahua: near Guacochic, *Goldman 179* (GH, US). Distrito Federal: Cerro del Tepalcate, cerca del Puerto de Las Cruces, *Rzedowski 21727* (DS, ENCB, F, MEXU, MICH, TEX, WIS). Durango: 8 mi NW of Estación Coyotes, *Breedlove 18778* (MICH). Hidalgo: Sierra de Pachuca, *C.G. Pringle 15007* (ASU, CAS, CM, COLO, F, GH, MICH, MSC, TEX, UC, US, VT). México: Valley of Toluca, *C.G. Pringle 4309* (CAS, F, GH, MEXU, MICH, MO, MSC, MU, NY, RSA, UC, US, VT). Michoacán: 6-7 mi N of San Pedro Aguaro, *McVaugh & Wilbur 9991* (MICH). Morelos: head of Lake Zempoala, *Correll 14282* (DUKE). Veracruz: Palo Bendito, Huayacocotla, *Hernández M. & Yolanda de Hdez. 974* (GH). Zacatecas: *Coulter 951* (K; photos in HAM seen).

The names *Pneumonanthe bicuspidata* G. Don and *Gentiana adsurgens* Cerv. ex Griseb. appear to have been based on the same collection, although on different specimens. This collection was made during the period 1788-1804 at some unspecified Mexican locality by the botanical expedition headed by Martín Sessé L., which included J.M. Mociño and Vincente Cervantes among its members (Standley, 1920). Sessé & Mociño designated this collection *Gentiana assurgens* in herb., but this name did not appear in their published works.

Don (1837) based the name *Pneumonanthe bicuspidata* on *Gentiana assurgens* Sessé & Mociño. His acquaintance with unpublished names proposed by Sessé & Mociño was based on duplicates of their collections in the herbarium of A.B. Lambert (as indicated in Don, 1837, passim). Sessé & Mociño collections from Lambert's herbarium are now in BM, G, and OXF (Miller, 1970). Of these three herbaria, only OXF contains a specimen of their *Gentiana assurgens*. Since this appears to be the only specimen of this collection likely to have been seen by Don, it has been selected as the lectotype of the name *Pneumonanthe bicuspidata* G. Don.

According to Miller (1970), Lambert received his Sessé & Mociño specimens from J.A. Pavón, who had selected duplicate material from that left at MA by Mociño. The annotation "Guayaquilensis" on the specimen of "*Gentiana assurgens*" at OXF may have been added by someone who confused *Gentiana assurgens* Sessé & Mociño, ined., with *Selatium assurgens* D. Don ex G. Don, which was based on a specimen in the Lambert herbarium collected by Ruiz & Pavón or Tafella at Guayaquil, and which was equated with *Gentiana guayaquilensis* Griseb. in *Index Kewensis*. Although

obviously erroneous, this annotation does help to link the OXF specimen to Lambert's herbarium and thus to Don.

Additional specimens that may be duplicates of the same collection by the Sessé expedition are at MA and F; those at F were examined during the present study. These bear Sessé & Mociño's label "*Gentiana assurgens* N[obis]" and the number *1368*, which was assigned by a curator at MA. Another collection, or possibly additional duplicates of the same collection, bear the label "*Gentiana adsurgens*" and the number *682*. In addition to the replicates of *Sessé et al. 1368* and *682* at MA and F, there is an unnumbered specimen in the type collection at GH labeled "*Gentiana assurgens* sp. n. Mexico" and, in another hand, "Cervantes" following the binomial, and "Fielding his writing?" This specimen is probably a duplicate of *Sessé et al. 1368* or *682*. All of the specimens in F, GH, and OXF cited above clearly represent the species treated here as *G. bicuspidata*.

Grisebach (1838), in publishing the name *G. adsurgens*, attributed the origin of this name to Cervantes. Cervantes never published this name, but presumably used it in herb. or in ms. The relationship between names proposed or published by Cervantes and those proposed or published by Sessé & Mociño has been discussed by McVaugh (1945), who concluded that "we are probably justified in supposing that the Sessé and Mociño plants [in MA and F] are to be regarded as the types of Cervantes' species." The name *G. adsurgens* Cerv. ex Griseb., therefore, seems to be best typified by the Sessé expedition collection numbered *1368*. The specimen seen by Grisebach may have been in B, where Grisebach worked on his *Genera et Species Gentianearum*, in which case it would not be extant.

Whether the specific epithet *bicuspidata* has priority over *adsurgens* has been the subject of some discussion (Briquet, 1931; Williams, 1968). Accordto Stafleu (1967), the first part of Vol. 4 of Don's *General History of the Dichlamydeous Plants* (which probably included *Pneumonanthe bicuspidata*) was published in 1837, and the entire volume had been published by 8 Apr 1838 or earlier. Grisebach's *Genera et Species Gentianearum*, in which this species was first described under the name *Gentiana adsurgens*, was published in early Oct 1838. Therefore, I accept *bicuspidata* as being the correct specific epithet for this taxon.

Gentiana bicuspidata is morphologically similar to *G. autumnalis* L., a species native to the Atlantic Coastal Plain from South Carolina to New Jersey. The most evident differences between these two species are as follows: The free portions of the corolla appendages of *G. bicuspidata* are triangular and are bifid near the summit, while those of *G. autumnalis* are proportionately lower and much divided; the margins of the corolla lobes of *G. bicuspidata* are entire or only slightly erose, while those of *G. autumnalis* are prominently erose-serrate; the calyx lobes of *G. bicuspidata* are abruptly acute, while those of *G. autumnalis* are acuminate; the tap root of *G. bicuspidata* is usually persistent and well developed, while that of *G. autumnalis* is soon replaced by several lesser roots; and the seed wing of

G. bicuspidata is much more prominent than that of *G. autumnalis*. *G. bicuspidata* averages lower in stature and probably higher in number of stems per plant than *G. autumnalis*, but there is considerable overlapping in the ranges of variation in both of these traits. The somatic chromosome number of 26, reported here for *G. bicuspidata*, has also been reported for *G. autumnalis* (as *G. porphyrio* J.F. Gmel.) by Rork (1949).

Gentiana bicuspidata and *G. autumnalis*, along with *G. ovatiloba* of Mexico and Guatemala and *G. pennelliana* Fern. of Florida, appear to be closely related, all having the characteristics of the "first group" of species recognized above, as well as having widely open corollas with large lobes and deeply cleft appendages, free anthers, more or less decumbent stems, and, with the exception of *G. ovatiloba*, linear leaves. The distribution of this group of closely related species (Fig. 1f) corresponds to a pattern recognized by many biogeographers, in which identical or closely related taxa occur on the Atlantic Coastal Plain of the United States and disjunctly in the highlands of central and southern Mexico. Species or groups exhibiting the distribution pattern may have different phytogeographic histories. In the case of the *G. autumnalis-G. bicuspidata* complex, however, it appears probable that its colonization of Mexico and Guatemala occurred subsequent to its establishment in northern North America, and that the Mexican and Guatemalan species were derived from an ancestral complex centered in more northern latitudes, rather than vice versa. This interpretation is indicated by the fact that sect. *Pneumonanthe* is distributed predominantly in North Temperate, rather than tropical, latitudes, with its southernmost populations being restricted to relatively cool, montane habitats, and both of the groups distinguished above are more widely distributed and more diverse in northern North America than in Mexico and Guatemala. The extent of the distribution of this complex both north and south of the disjunction in its range and its differentiation into two species in each segment of its range indicate that this complex has had a relatively long history in both regions, rather than having recently colonized one of these regions through long-distance dispersal.

The scattered populations of *G. bicuspidata* in the Sierra Madre Occidental may be remnants of a more extensive and more nearly continuous distribution in the past, when climatic conditions permitted greater development of mesic vegetation. The assumption that the northwestern outliers of *G. bicuspidata* are relictual could account for patterns of variation in this species. Such traits as relatively short corolla lobes in some specimens from Chihuahua may be due to past introgression of genetic material from the *G. affinis* complex when both species-groups were more widely distributed in western North America; reciprocal introgression may account for the occurrence of long-branched individuals of *G. affinis* (= *G. interrupta* Greene) near the Mexican-United States border.

Plants of this species bearing only one flower per stem were segregated by Kusnzow (1894) as *G. adsurgens* [var.] β *uniflora*. Herbarium and field

studies of *G. bicuspidata* indicate that such variation commonly occurs among plants in a single population and even among the stems on a single plant, and is without taxonomic significance.

Gentiana angusta was described by Jones (1908) from plants found 18 Sep 1903 "in meadows along with other gentians, Mound Valley, Sierra Madre Mts., Chihuahua . . . at 7000 feet alt." In the paper in which he described *G. angusta*, Jones stated that the type specimens of all new names published therein were in his personal herbarium. No such specimen is at POM, which later acquired Jones's herbarium, but a collection reasonably compatible with Jones's description of *G. angusta*, and bearing identical data, is at DS, one of the many herbaria to which Jones sent specimens during his lifetime. This collection comprises three plants mounted on one sheet, all of which are entirely characteristic of *G. bicuspidata*, except that the corolla lobes are relatively short for this species. This collection is labeled "*Gentiana linifolia*," with no author's name. It seems probable that this is the type collection for the name *G. angusta*. *Gentiana linifolia* may have been Jones's first choice for a name for these plants and may later have been replaced in his paper but not corrected on the label when he found that this name was preoccupied. These specimens do indicate clearly that a collection of *G. bicuspidata* was made by Jones at Mound Valley on 18 Sep 1903 and was considered by him to represent a taxon to which no name then in use should be applied (the names *G. linifolia* Salisb. and *G. linifolia* Willd. ex Schult., based on European plants, having long since passed into obscurity). For these reasons, and because no other Jones specimens of *Gentiana* from Mound Valley appear to exist, *G. angusta* M.E. Jones is treated here as being a taxonomic synonym of *G. bicuspidata* (G. Don) Briq.

2. GENTIANA OVATILOBA Kusn., Trudy Imp. S.-Peterburgsk. Bot. Sada (Acta Horti Petrop.) 13:60. 1893. Type: MEXICO: [Distrito Federal]: Desierto Viejo, Valle de México, *Bourgeau 1123-bis*, 17 Oct 1866, holotype LE, isotype (not cited by Kusnezow) GH!

Gentiana caespitosa Mart. & Gal., Bull. Acad. Roy. Sci. Bruxelles 11(1):370. 1844, non *G. cespitosa* Willd. ex Schult. in Roem. & Schult., Syst. Veg. 4:185. 1819, nec *G. caespitosa* R. Graham, Edinburgh New Philos. J. 10:367. 1830. Type: MEXICO: Veracruz: Pic d'Orizaba, 10000 [Paris ft], *Galeotti 1483*, "184-" (date incomplete, probably actually 1838), P, photos in F!, MO!, NY!

Gentiana guatemalensis Standley & Steyerm., Publ. Field Mus. Nat. Hist., Bot. Ser. 23:75. 1944. Type: GUATEMALA: Huehuetenango: alpine meadow, region of Chémal, Sierra de los Cuchumatanes, alt. about 3300 m, *Standley 81113*, 28 Dec 1940, holotype F!, isotype GH!

Gentiana lewisiae Standley & Steyerm., Publ. Field Mus. Nat. Hist., Bot. Ser. 23:76. 1944. Type: GUATEMALA: Totonicapán: damp meadow, Pacajá, region of Desconsuelo, mountains above Totonicapán, alt. 3100-3200 m, *Standley 84556*, 23 Jan 1940, F!

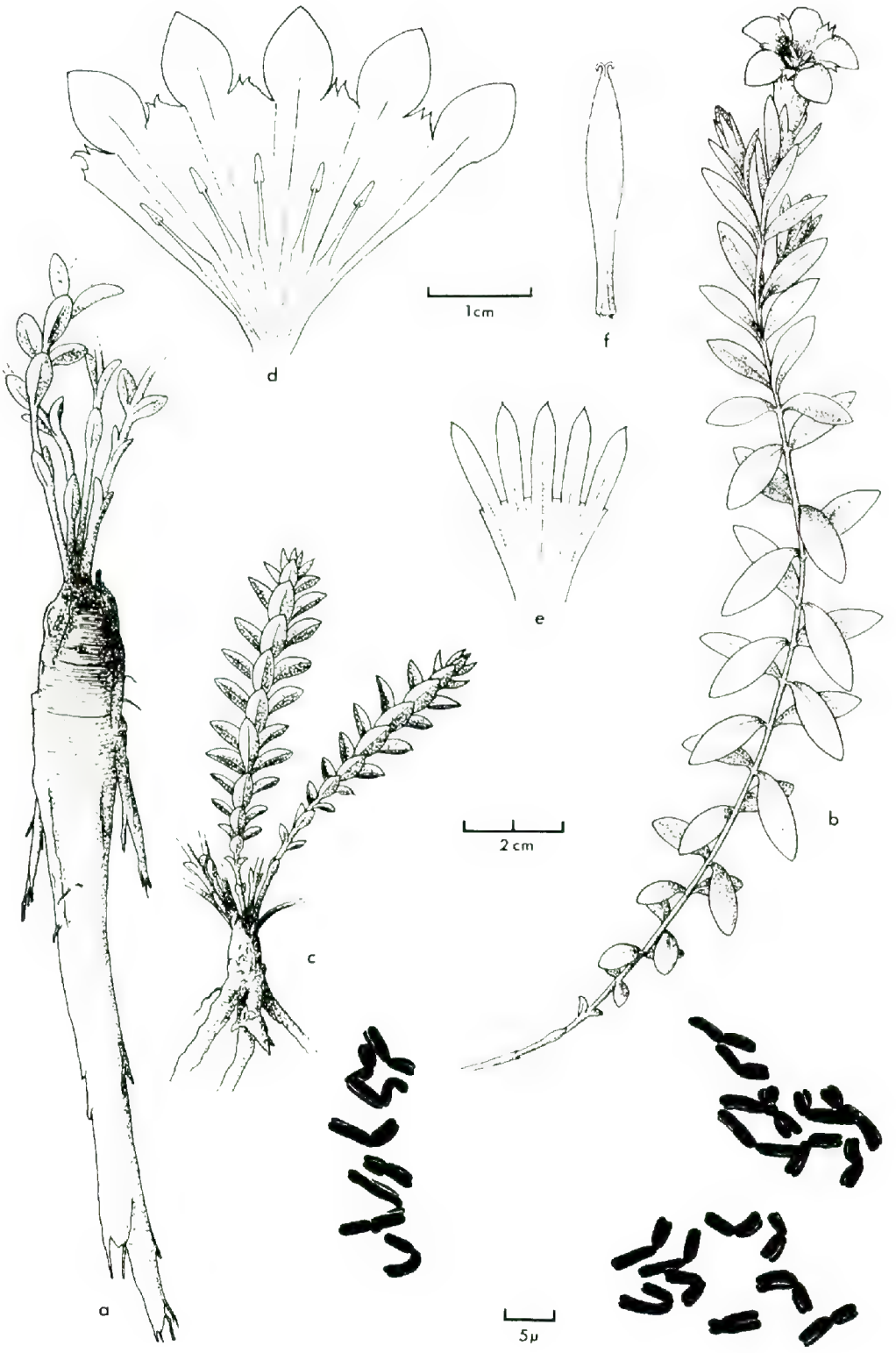

Fig. 3. *Gentiana ovatiloba*. a, root of plant from deep soil; b, flowering stem; c, portion of plant from dry, shallow soil; d, interior surface of corolla, and e, exterior surface of calyx, slit longitudinally and pressed; f, pistil; g, somatic chromosomes.

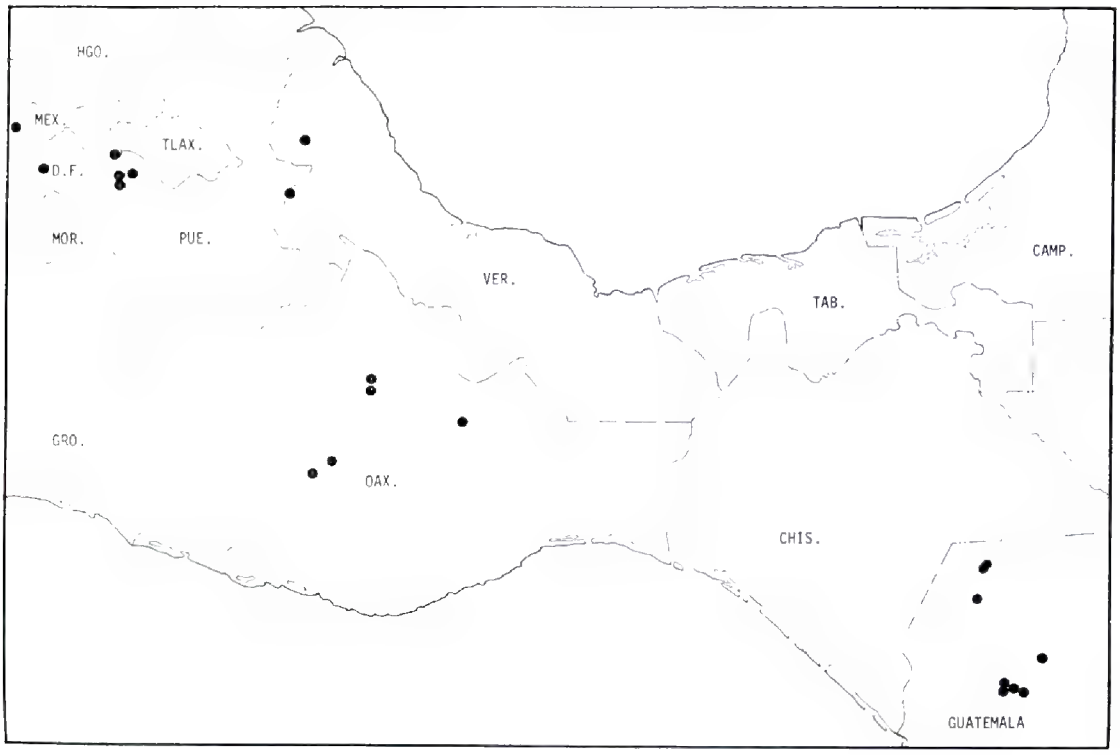

Fig. 4. Documented distribution of *Gentiana ovatiloba*.

Tap root usually persistent, 1-1.8 cm in diameter at summit and 0.7-1.5 dm long, often forked distally and producing branch roots; older plants often bearing many stout secondary roots from branches and divisions of the geocorm, these divisions sometimes becoming essentially independent. Stems cespitose, usually 2-12, occasionally more, decumbent to erect, 1-6 dm long, glabrous except for a few minute projections in lines below leaf bases, simple or with 1-7 short branches near summit. Leaves somewhat succulent, bright green, elliptic, largest near middle of stem, only the lowest much reduced, evenly and closely spaced, obtuse to rounded at apex, rounded at base. Leaf margins smooth, flat or somewhat revolute. Largest leaves 1-3 cm long, 2.5-3.5 times as long as broad. Flowers solitary or in racemose or corymbose clusters of 1-8 through the production of short branches near summit of main stem. Flowers usually closely subtended by uppermost pair of leaves, but without differentiated bracts. Calyx tube uncleft, 6.5-10 mm long, glabrous. Calyx lobes erect, oblong to narrowly elliptic-ovate, 5-12 mm long, obtuse, sometimes apiculate. Corolla 2.5-4.5 cm long, the tube funnelform. Corolla lobes spreading, ovate-triangular or broadly ovate to elliptic-rhombic, 3.5-8.5 mm long, sparingly erose-serrate to nearly entire, the apices obtuse to acute, the sinuses subequal. Free portions of the appendages 2-4 mm long, basically bifid with the segments variously toothed or cleft, the

ultimate divisions acute to attenuate. Lower ¾ of corolla tube pale, increasingly suffused with blue upward, with bronze-purple suffusions on exterior surfaces of petals proper, and purplish stripes (varying in distinctness) on interior surfaces between midvein and lateral veins. Upper part of corolla tube, lobes, and free portions of appendages blue, exterior surface of lobes suffused with green except near inner margin, and with bronze-purple near outer margin. Blue pigment sometimes very pale, or replaced by violet. Interior corolla surfaces unspotted or (in northern populations) with a few yellowish-green spots near base of lobes. Stamen filaments becoming free about ¼ the height of corolla tube, free portions 4.5-6 mm long. Anthers ca. 3.5 mm long, not cohering. Fruit slightly exserted from marcescent corolla at maturity. Seeds similar to those of *G. bicuspidata*. $2n = 26$ (voucher specimen: MEXICO: México: Cañada de Alcalican, SW side of Ixtaccíhuatl, *J.S. Pringle & T. Duncan 1509*, 22 Jun 1974, HAM).

Gentiana ovatiloba grows in the highest mountains in the Neovolcanic belt from western Veracruz west to the Distrito Federal, and in the Sierra Madre del Sur in Oaxaca. Disjunct populations are present in the mountains of western Guatemala (Fig. 4). Reports of "*G. adsurgens*" in Chiapas, e.g. by Standley & Williams (1969), which one might expect to have been based on *G. ovatiloba*, actually appear to have been based on specimens of *G. laevigata*. *Gentiana ovatiloba* is usually found in the alpine grasslands just above treeline, with occasional populations extending to open, exposed sites in the *Pinus hartwegii* or *P. rudis* zones. Most plants of *G. ovatiloba* are found along streams and in seasonally moist depressions, associated more with rushes and mesophytic forbs than with the dominant bunchgrasses. Occasional plants, however, occur in shallow, dry soils near rock outcrops. The flowering season extends from August to March, and sporadically through the summer in some populations.

Representative specimens examined:

GUATEMALA: Huehuetenango: 7 mi N of Santa Eulalia, *Breedlove 8597* (DS, F, US). Sololá: 10-12 km NW of Los Encuentros, *Williams et al. 27307* (F, NY). Totonicapán: about 12 km SW of Totonicapán, *Williams et al. 25462* (F, NY, US). MEXICO: México: Cañada de Alcalican, Ixtaccíhuatl, *Rzedowski 21569* (DS, ENCB, MICH, WIS). Oaxaca: Zempoaltepetl, *Camp 2666* (A, MICH, NY, RSA, UC). Puebla: ládera NE de Ixtaccíhuatl, *Ern 300* (ENCB). Veracruz: Cofre de Perote, NW side of mountain, *Beaman 2189* (GH, MSC).

Collections of *G. ovatiloba* from Guatemala have consistently been recognized as being specifically distinct from *G. bicuspidata*. Standley & Steyermark (1944) and Standley & Williams (1969) considered *G. guatemalensis* and *G. lewisiae*, as they designated these plants, to be endemic to Guatemala, evidently having accepted the Mexican representatives of this complex as being "*G. adsurgens*." In recent years, specimens from Oaxaca have, with increasing frequency, been equated taxonomically with the Guatemalan material, usually as *G. guatemalensis*. To date, however, specimens

virtually indistinguishable from the Guatemalan plants have generally been included in *G. bicuspidata* (or "*G. adsurgens*") if they were collected north of Oaxaca.

The most conspicuous differences between *G. ovatiloba* and *G. bicuspidata* are the following. The leaves and calyx lobes of *G. ovatiloba* are proportionately much wider than those of *G. bicuspidata*. The leaves of *G. ovatiloba* are more closely spaced than those of *G. bicuspidata*, especially toward the summit of the stem, where the leaves of *G. bicuspidata* are often widely separated. *Gentiana bicuspidata* sometimes produces flowering branches several cm long, with two or more pairs of leaves, whereas the branches of *G. ovatiloba* are almost always short and peduncle-like. The corolla lobes of *G. ovatiloba* are ovate to ovate-triangular and are blunt; those of *G. bicuspidata* are elliptic to suborbicular, widest near or above the middle, and are generally apiculate. The interior surface of the corolla of *G. bicuspidata* is conspicuously spotted with yellowish-green, especially near the base of the lobes; such spots are usually absent from the corollas of *G. ovatiloba*, although not invariably so in the northernmost part of its range. The free portions of the corolla appendages of *G. bicuspidata* tend to be proportionately longer than those of *G. ovatiloba*. Both the stamen filaments and the anthers of *G. bicuspidata* are longer than those of *G. ovatiloba*, with the anthers of the former thus being nearer the throat of the corolla.

Despite this rather extensive list of differences, *G. ovatiloba* and *G. bicuspidata* appear to be very closely related. Most plants of this complex can be readily and unequivocally assigned to one or the other of these species, but occasional specimens deviate from the typical form of one species in having one or more traits, usually vegetative, like those of the other species. For example, *Lyonnet 458* (GH, NY, US), from the Desierto Viejo, Distrito Federal, where both *G. bicuspidata* and *G. ovatiloba* have been collected, is typical of the former species in general habit and in corolla morphology but has exceptionally broad, blunt leaves and calyx lobes. A duplicate of this collection in F, however, falls within the usual range of variation in *G. bicuspidata*. A joint, but independently numbered, collection by Pringle & Smith from the Sierra de Clavellinas, southwest of the city of Oaxaca (*C.G. Pringle 4985*, GH, MICH, US, VT; *Smith 752*, MO, NY), and *Nelson 1400* (GH, US), from the same general area, consist of plants that are typical of *G. ovatiloba* in habit, leaf spacing, and floral morphology but have narrower leaves (mostly 2-4 mm wide) than those ordinarily found in this species.

Most of the alpine zones constituting the habitat of *G. ovatiloba* are at elevations that resulted from Pliocene and Pleistocene uplift and volcanic activity, with the exception of those in the somewhat older Sierra de los Cuchumatanes in the southern part of its range. This association with relatively recently formed habitats suggests that *G. ovatiloba* is probably the latest product of evolution in the *G. bicuspidata* complex, representing an adaptation to alpine conditions.

Standley & Steyermark (1944), as noted above, treated the Guatemalan representatives of *G. ovatiloba* as two species, *G. guatemalensis* and *G. lewisiae*, which were originally contrasted as follows: *G. guatemalensis*—flowers 1-3 per stem; calyx tube ca. 8 mm long; calyx lobes ca. 10 mm long; corolla ca. 2.5 cm long; segments of the free portions of the corolla appendages acute to acuminate, sparsely serrate. *G. lewisiae*—flowers solitary; calyx tube 5-6 mm long; calyx lobes 4-7 mm long; corolla ca. 2 cm long; segments of the free portions of the appendages rounded, entire. In 1969, however, both *G. guatemalensis* and *G. lewisiae* were described by Standley & Williams as having 1-few flowers per stem. These authors then noted that *G. guatemalensis* and *G. lewisiae* "are perhaps too much alike and the distinctions tend to disappear with additional collections."

As mapped by Steyermark (1950), the alpine zones, which are the habitat of *G. ovatiloba*, are restricted to two areas in Guatemala: the Sierra de los Cuchumatanes, the source of the more northern records for Guatemala mapped in Fig. 4; and the Sierra Madre, the source of the records for southern Guatemala. Thus isolated from each other as well as from the Mexican populations, these Guatemalan populations do appear to have differentiated to the extent that plants from the Sierra Madre tend to be smaller, in stature and in the size of their leaves and flowers, than plants from the Sierra de los Cuchumatanes or from Mexican populations. However, the study of additional Guatemalan material which has become available since the description of *G. guatemalensis* and *G. lewisiae*, the inclusion of specimens from Mexico as well as from Guatemala in the present study, and field observations of sizeable populations occupying diverse microhabitats indicate that *G. guatemalensis* and *G. lewisiae* cannot justifiably be maintained as separate species. Quantitative variation appears to be essentially continuous within this species, with no evident discontinuity separating the Sierra Madre plants from those of other regions. No qualitative differences were discerned between the type specimens of *G. lewisiae* and *G. guatemalensis*, or between specimens from the Sierra Madre and those from the Sierra de los Cuchumatanes or from Mexico. The divisions of the corolla appendages appear to be as acute in the type collection of *G. lewisiae*, and in other specimens from the Sierra Madre which have been identified as *G. lewisiae*, as in the type collection of *G. guatemalensis* or in other specimens from Guatemala or Mexico.

Limited local variation also appears to have developed among the Mexican populations of *G. ovatiloba*. As I observed on Ixtaccíhuatl, for example, stems of large and small plants alike bore only one flower per stem, whereas in the Sierra Juárez, Oaxaca, flowers were almost invariably borne in racemes of two or more. Within the Ixtaccíhuatl population, variation not evidently correlated with environmental factors was noted in corolla color and lobe length. Microenvironmental factors also appear to contribute significantly to variability of *G. ovatiloba*; plants in relatively dry, exposed sites differ conspicuously in stem height and in spacing and condu-

plicateness of the leaves from those growing among dense vegetation in wet depressions (Figs. 3b and 3c).

3. GENTIANA **hooperi** Pringle, species nova. Fig. 5.

Herba perennis, glabra. Caules 1-6, ascendentes, 0.3-2 dm longi. Folia griseo-viridia, aliquanto succulenta, obtusa, maxima 2-4.5 cm longa in parte caulis inferiore. Flores vulgo solitarii, interdum racemosi 2-4, exinvolucrati. Tubus calycis infissus, 8-16 mm longus. Lobi calycis linear-subulati, acuminati, 2-5 mm longi. Corolla infundibuliformis, 3.5-5.5 cm longa. Lobi corollae elliptico-obovati, patentes, 6-10 mm longi, 4.5-9 mm lati, integres, obtusi, violaceo-lazulini, albomarginati, e viridi-purpureo extra. Partes librae plicarum 2-4 mm longae, 3-5 mm latae, bifidae segmentis laciniatis, medium tubi corollae; partes librae 5-7 mm longae.

Type: MEXICO: Aguascalientes: Municipio San José de la Gracia, high plateau in the Sierra Fría ca. 8 km SW of La Congoja, ca. 22° 10′ N, 102° 33′ W, 7 Feb 1972, *J.S. Pringle 1320* (holotype HAM, isotypes CAN, HAM, K, MEXU, MICH, NY, S, TENN). Topo-paratype, from the same locality, expressed as " 'Sierra Fría' 15 mi W of Presa Calles": *Hooper* 10 Mar 1953 (MICH). Additional paratypes: MEXICO: Chihuahua: vicinity of Miñaca, *Rose 11645* (US). Durango: Sierra de San Francisco, *Foshag* Feb 1941 (MEXU); Sierra de Carcaría, near Rio Verde, *Foshag* 28 Feb 1941 (ENCB, US).

Several subequal roots 1.5-8 mm in diameter usually present. Stems 1-6, decumbent to ascending, 0.3-2 dm long, glabrous, simple or with 1-4 short branches. Leaves gray-green, often suffused with purple, rather succulent, somewhat conduplicate, especially upper ones, linear or lower ones narrowly elliptic to oblanceolate, obtuse at extreme apex, tapering at base, upper leaves strongly ascending, median and lower leaves moderately ascending or spreading. Leaf margins very narrowly cartilaginous, minutely denticulate proximally, entire distally, the cartilaginous margin usually abruptly widened in distal 1-3 mm. Leaves largest on lower half of stem, upper leaves gradually reduced to 1/3-2/3 the length of the largest leaves, only those near and below the soil line scalelike. Largest leaves 2-4.5 cm long, (4-)8-30 times as long as wide. Flowers solitary at end of main stem and branches, occasionally appearing racemose if several reduced branches are present, exinvolucrate or subtended only by uppermost pair of leaves. Calyx tube uncleft, 8-16 mm long, glabrous. Calyx lobes erect, linear-subulate, 2-5 mm long, acuminate. Corolla 3.5-5.5 cm long, tube funnelform, with lower half slender, widening very gradually upward, upper half more abruptly flaring. Corolla lobes spreading, elliptic-obovate, 6-10 mm long, 4.5-7(-9) mm wide, entire, obtuse, sinuses about equal on both sides. Free portions of appendages 2-4 mm long, 3-5 mm wide, bifid, divisions further irregularly toothed or cleft, ultimate segments acute to attenuate. Corolla tube greenish-white below, increasingly suffused upward with violet-blue and externally with green, in the petals proper. Corolla lobes violet-blue (often similar in color to corollas of typical *Vinca minor* L., sometimes

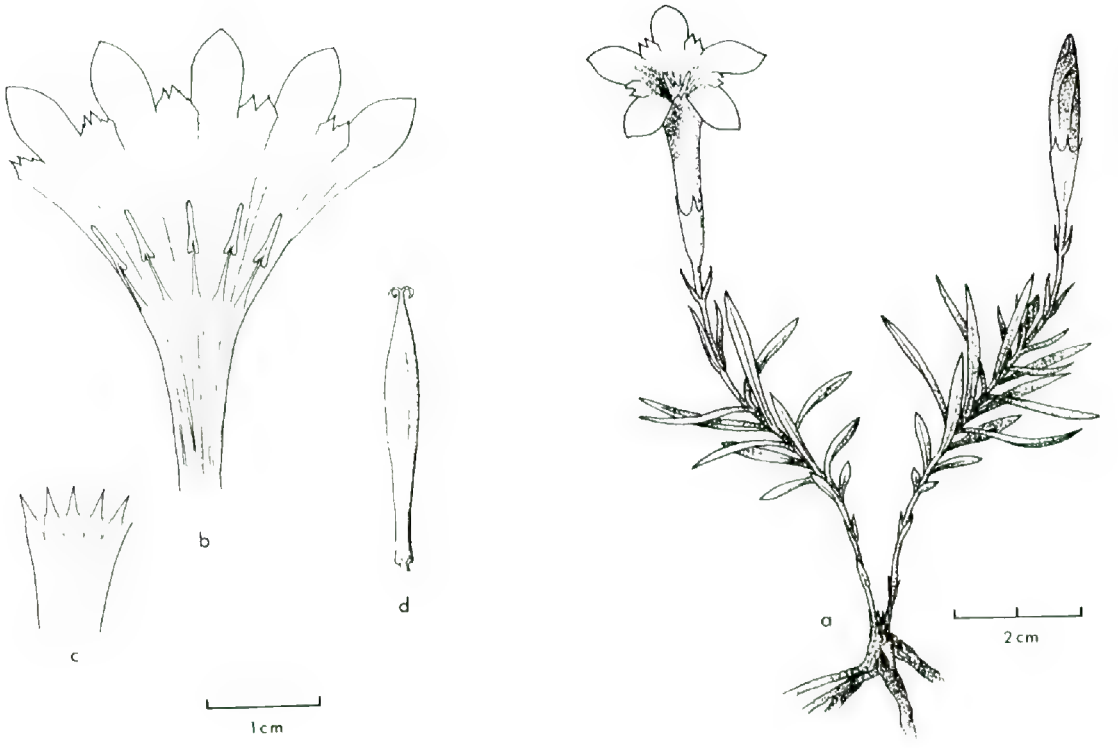

Fig. 5. *Gentiana hooperi*. a, flowering plant; b, interior surface of corolla, and c, exterior surface of calyx, slit longitudinally and pressed; d, pistil.

paler or bluer, occasionally nearly white), narrowly white-margined, the exterior surface suffused with green except near inner margin, and with purple near outer margin. Dark blue-violet, usually interrupted, streaks present on inner surface of the upper ¼-½ of corolla tube between midrib and lateral veins of each petal, extending into the lobes as rows of dots; additional spots or short streaks occasionally present at juncture of petals proper and appendages. Midribs narrowly outlined with green on both surfaces. Appendages white throughout, or fused portions with a faint to prominent blue patch on each side near summit. Stamen filaments becoming free at or slightly below middle of corolla tube, free portions 5-7 mm long. Anthers free at anthesis. Fruit and seeds not seen.

Gentiana hooperi is named for Emmet T. Hooper, Curator of Mammals, University of Michigan Museum of Zoology, whose collection of this species was the first I saw, and whose directions enabled me to visit the type locality.

To date, *G. hooperi* has been collected only at four widely separated localities, all in the lower, eastern ranges of the Sierra Madre Occidental (Fig. 2). At the type locality in the Sierra Fría in northwestern Aguascalientes, some plants of *G. hooperi* were found in swampy sites (dry at flower-

ing time) among relatively dense stands of *Juncus* species and other graminoids. Other plants grew on higher ground where only a sparse herbaceous layer was present, among widely scattered small trees of *Juniperus deppeana* Steud., some of the gentians being in seasonally moist depressions, others in very dry, exposed sites. *Gentiana hooperi* was just coming into bloom when the type collection was made in early February; the other collections, for which dates are given above, also comprise plants in flower.

The slender corolla tube of *G. hooperi*, which flares widely only near the summit, and the linear, succulent, gray-green leaves give this species an aspect superficially similar to that of some species in sect. *Frigidae* Kusn. The leaf margins also resemble those of species in sect. *Frigidae*. The habit of growth of *G. hooperi*, however, clearly indicates that its affinity is with sect. *Pneumonanthe*, since species in sect. *Frigidae* have slender, creeping rhizomes from which either overwintering or permanent rosettes arise. The well-developed, bifid free portions of the corolla appendages of *G. hooperi* are also more characteristic of sect. *Pneumonanthe* than of sect. *Frigidae*.

The closest relatives of *G. hooperi* are probably *G. bicuspidata* and *G. ovatiloba*. It is, however, well differentiated from these species and may have had a relatively long history of isolation. Although additional populations of *G. hooperi* may remain to be discovered, its distribution is obviously sporadic and disjunct and is probably best regarded as comprising the remnants of a more nearly continuous distribution in the past.

Gentiana hooperi is generally of lower stature than *G. bicuspidata*, even when plants growing in apparently similar habitats are compared. The leaves of these species differ markedly in color and texture. The acuteness of the upper leaves of *G. bicuspidata* also contributes to the difference in aspect between it and *G. hooperi*. The calyx lobes of *G. hooperi* are shorter and, in contrast to the leaves, more sharply pointed than those of *G. bicuspidata*.

The corolla of *G. hooperi* is significantly different is shape from that of *G. bicuspidata*, the corolla tube of *G. hooperi* being prolonged and slender, as noted above, in contrast to the proportionately broader corolla tube of *G. bicuspidata*. The corolla lobes of *G. bicuspidata* are usually apiculate, whereas those of *G. hooperi* are obtuse (although the inrolling of the margins, before the corolla has fully expanded, may temporarily create the appearance of apiculate lobes on newly opened corollas). The illustrations of these species show the marked difference in the levels at which the stamens become free from the corolla tubes.

Two aspects of corolla pigmentation present especially obvious differences between *G. hooperi* and *G. bicuspidata*. The basic color of the corollas of *G. hooperi* is a slightly grayed periwinkle-blue, with an appreciable violet content, while that of the corollas of *G. bicuspidata* is a true blue, varying in intensity but with very little violet content. The predominantly white free portions of the appendages of *G. hooperi* are conspicuous and contrast with the blue lobes. In *G. bicuspidata*, the lobes and appendages are similar in

color. Other differences between *G. hooperi* and *G. bicuspidata* can be noted from the descriptions and illustrations of these species.

4. GENTIANA SPATHACEA H.B.K., Nov. Gen. Sp. 3:173 (quarto text). "1818" [1819].

   Type: MEXICO: [Veracruz]: in declivitate orientali montium Mexicanorum, prope urbem Xalapae, alt. 700 hex., *Humboldt s.n.*, no date, P, photos in F!, MO!, US! Fig. 6.

   Gentiana plicata Willd. ex Schult. in Roem. & Schult., Syst. Veg. 6:185. 1820. Type: duplicate of type collection of *Gentiana spathacea*, cited above, B-herb. Willd., photos in HAM!

   Coilantha sessaei D. Don ex G. Don, Gen. Hist. 4:185. 1837. Type: MEXICO: no further locality data published, *Sessé et al.* collection formerly in herb. A.B. Lambert, not located, probably not extant. (Ex char.)

   Coilantha mocinni D. Don Ex G. Don, Gen. Hist. 4:185. 1837. Type: MEXICO: no further locality data published, *Sessé et al.* collection formerly in herb. A.B. Lambert, not located, probably not extant. (Ex char.)

   Ericala spathacea (H.B.K.) G. Don, Gen. Hist. 4:191. 1837.

   Gentiana ovalis Mart. & Gal., Bull. Acad. Roy. Sci. Bruxelles 11(1):369. 1844. Type: MEXICO: [Veracruz]: Xalapa, 6000 [Paris ft], *Galeotti 1486*, no date, G, photos in F!, GH!, MICH!, NY!, US!

   Gentiana sessaei (G. Don) Griseb. in DC., Prodr. 9:112. 1845.

   Gentiana spathacea [var.] β *Benthami* Griseb. in DC., Prodr. 9:113. 1845. Type: MEXICO: [Hidalgo]: Velasco, prope Real del Monte, *Hartweg 349*, 1839, holotype K, photos in F!, MICH!, isotype NY!

   Gentiana coerulea Sessé & Mociño, Naturaleza (Mexico City), ser. 2, 1(App.):44. 1888, etiam *G. caerulea* [sic] Sessé & Mociño ex G. Don, Gen. Hist. 4: 185. "1838" [1837], pro syn., et *G. coerulea* Sessé & Mociño ex. Griseb. in DC., Prodr. 9:112. 1845, pro syn., non *G. coerulea* Ruiz & Pavón ex Griseb., Gen. Sp. Gentianearum p. 235. "1839" [1838], pro syn. Type collection: MEXICO: no further locality data, *Sessé et al. 897* (no. assigned by a later curator at MA), no date, MA, F!

   Gentiana spathacea [var.] φ *integra* Kusn., Trudy S.-Peterburgsk. Obshch. Estestvoisp., Otd. Bot. 24(2):53. 1894. No type indicated.

   Pneumonanthe spathacea (H.B.K.) Greene, Leafl. Bot. Observ. Crit. 1:71. 1903.

   Dasystephana spathacea (H.B.K.) Arthur, Torreya 19:49. 1919.

   Tap root persistent, usually 1-2 cm in diameter at summit and 1.5-2 dm long, generally forked and bearing branch roots distally, often accompanied by several-many thick secondary roots arising from the elongating, sometimes much branched and divided geocorm. Stems 1-20(-50 or more), ascending to erect, 1-10 dm tall, minutely papillose-puberulent or glabrous. Leaves bright green, lanceolate to broadly ovate, prominently 3-nerved (the larger ones also having 1 or 2 pairs of less prominent nerves), rounded at base, acute at apex, with margins entire and minutely revolute. Larger leaves 2.5-8 cm long, 2-5(-6) times as long as wide. Leaves largest a short

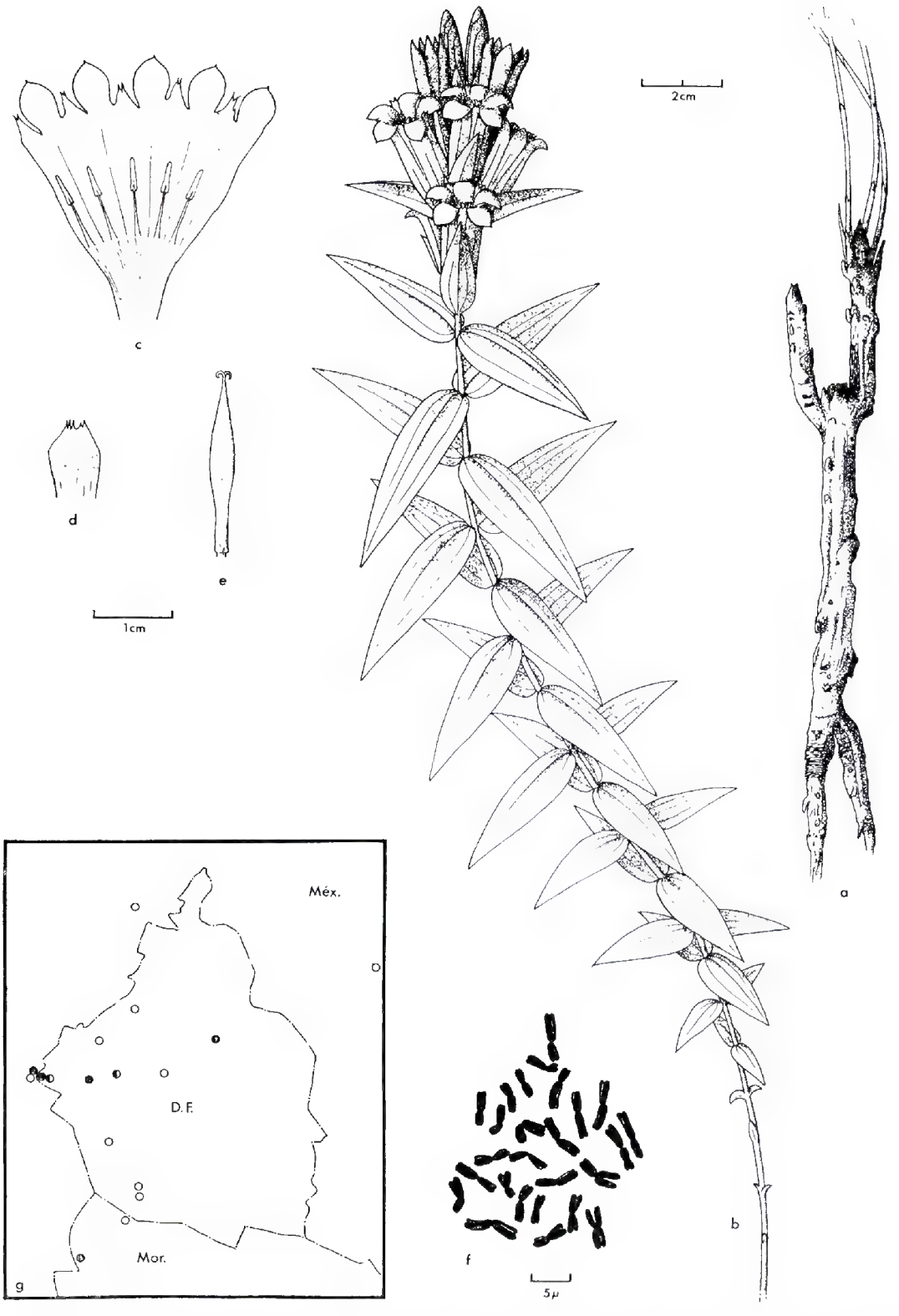

Fig. 6. *Gentiana spathacea*. a, underground portions; b, flowering stem; c, interior surface of corolla, and d, exterior surface of calyx, slit longitudinally and pressed; e, pistil; f, somatic chromosomes; g, documented distribution of *G. spathacea* (open circles), *G. bicuspidata* (closed circles), and mixed populations including hybrids (half-closed circles) in the Distrito Federal and vicinity.

distance below summit of stem, slightly reduced above, gradually reduced to small scales near base of stem. Flowers solitary or in small sessile or short-pedunculate groups in upper 1-8 (rarely more) axils and in terminal clusters of 3-30, those in clusters subtended by pairs of reduced leaves or linear bracts (see discussion below). Calyx tubes typically cleft to base on one side, hence spathelike, 5-10 mm long, herbaceous below, hyaline above, glabrous. Calyx lobes usually subulate, less than 1 mm long, closely spaced at summit of the tube opposite the cleft. Occasional plants with calyces larger, herbaceous throughout, less deeply or not at all cleft, with oblong-oblanceolate lobes up to 6 mm long and more evenly spaced. Corollas 2.5-4(-5) cm long, tubes urceolate-campanulate. Corolla lobes spreading, broadly ovate-elliptic to orbicular, 4-8(-10) mm long, 2.5-6.5 mm wide, entire, apiculate, sinuses on each side almost equally deep. Free portions of appendages erect, 3-6 mm long, 2.5-4 mm wide, tapering into 2 subequal, closely spaced, attenuate teeth, sometimes with lesser teeth or irregularities along the margin. Lower 2/5 of corolla tube whitish, remainder of corolla blue, becoming deeper in color upward, especially in the petals proper, the deep blue of lobes extending downward on interior surface of the tube in stripes between the midrib and lateral veins. Petals below the lobes, and the outer margin of each lobe, very dark and suffused with purple on exterior surface. Appendages lighter, but blue throughout. Stamen filaments becoming free at ca. 3/8 the height of corolla tube, free portions ca. 6 mm long. Anthers loosely coherent or free at anthesis, ca. 3 mm long. Fruits only slightly exserted from corolla at maturity. Seeds ca. 2 mm long, 0.7 mm wide, winged, wing very narrow on one side, $2n = 26$ (voucher specimen: Hidalgo: 2.6 km N of Mexico Hwy. 105 on road to Mineral del Chico, *J.S. Pringle 1305a*, 28 Jan 1972, HAM).

The range of *G. spathacea* largely coincides with the boundaries of the Neovolcanic Plateau, extending from Veracruz west to Jalisco, although it reaches the southernmost portions of the Sierra Madre Oriental in Hidalgo and southern San Luis Potosí and has been collected at one locality in the northwestern part of the Sierra Madre del Sur in Guerrero (Fig. 7). Most populations of *G. spathacea* are in the upper reaches of the pine-oak forest and in the pine-alder-fir zone; a few extend to the fir forest zone. Within these zones, the usual habitat of *G. spathacea* consists of partially shaded, generally well-drained slopes, often in a small opening or near the edge of the woods. Specimens have been collected in flower from August through April. Plants in the drier microhabitats usually bloom in autumn or early winter and may be found with ripe fruits and desiccated stems in late winter, while plants in moister sites are then in bloom.

Representative specimens examined:

MEXICO: Distrito Federal: Sierra de Ajusco, *C.G. Pringle 6221* (CAS, CM, F, GH, MEXU, MICH, MO, MSC, NY, TEX, UC, US, VT). Guanajuato: 2 mi S of Santa Rosa, *Harker & Mellowes 145* (ENCB, WIS). Hidalgo: Sierra de Pachuca, *C.G. Pringle 15006* (ASU, CAS, COLO, GH, MICH, MSC, TEX,

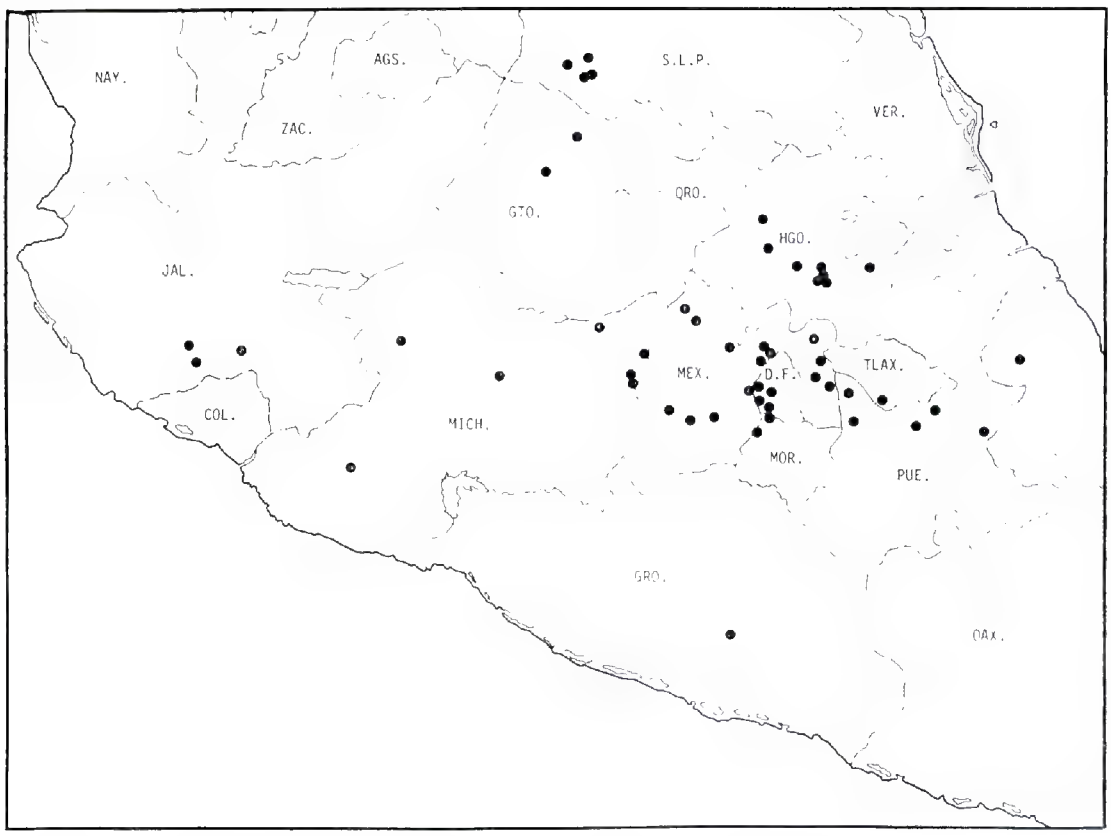

Fig. 7. Documented distribution of *Gentiana spathacea*.

UC, US, VT). Jalisco: Nevado de Colima, *McVaugh & Hoover 11615* (MEXU, MICH, US). México: Meson Viejo, *Hinton et al. 8973* (ENCB, F, GH, MICH, MO, NY, US). Michoacán: Zitácuaro - Copándiro, *Hinton et al. 13551* (MICH, NY, US). Morelos: Toro, *Matuda 21923* (MEXU). Puebla: near La Venta, *Sharp 441853* (GH, HAM, MEXU, MO, NCU, NY, TENN). San Luis Potosí: 5 km al N de Soledad de Zaragoza, *Rzedowski 7095* (ENCB, MEXU, TEX). Tlaxcala: am Fuss der Ruines Cacaxtla, *Seler & Seler 3556* (GH).

Gentiana spathacea appears to be most closely related to the *G. affinis* complex of western North America north of Mexico, although not exhibiting so close a relationship as that of *G. bicuspidata* to *G. autumnalis*. This group of species is also more widely distributed, and includes more taxa, in northern North America than in Mexico. At times during the Tertiary, northern, mesophytic species-groups were evidently more widely distributed in the Southern Rocky Mountains and the Sierra Madre Occidental; it seems likely, therefore, that the range of the *G. affinis-G. spathacea* group was more nearly continuous in the past, and variation within this group may formerly have been clinal. The present degree of differentiation of *G. spathacea* from related species, however, along with its extensive distribution and variability on the Neovolcanic Plateau and in adjacent regions, indi-

cates that this species has probably had a relatively long history in Mexico.

Gentiana rusbyi Greene ex A. Gray, from the Mogollón Mountains of New Mexico, was described (Gray, 1886) as being intermediate between *G. affinis* (as *G. bigelowii* A. Gray, a taxonomically insignificant variant) and *G. spathacea*. Examination of the type collection, *Rusby 263* (MICH, MO, NY), however, indicates that plants so designated are entirely typical of *G. affinis* in habit, foliage, and corolla morphology, differing only in having reduced calyx lobes. According to Hitchcock (1959), such plants occur sporadically throughout much of the range of *G. affinis* and do not warrant taxonomic recognition. It appears, therefore, that *G. rusbyi* should be included within *G. affinis* and need not be interpreted as connecting *G. affinis* with *G. spathacea*.

Variants of *G. spathacea* have been recognized taxonomically by several authors. It was first treated as more than one species by Don (1837), who divided it into three species in two genera. *Coilantha sessaei* was based on a Sessé & Mociño collection in the herbarium of A.B. Lambert, which had been designated *G. coerulea* by its collectors. The specimen seen by Don in Lambert's herbarium could not be located in BM, G, or OXF, the three herbaria known to have received Sessé expedition specimens from the Lambert herbarium. Examination of a duplicate of this collection in F, however, has confirmed that *G. coerulea* Sessé & Mociño, and hence *C. sessaei* G. Don, are synonymous with *G. spathacea* H.B.K.

Don's (1837) description of *Ericala spathacea* is simply a paraphrase of the description of *G. spathacea* by Humboldt et al. (1819), and contains no indication that Don had examined any specimens thus identified. It is not clear from Don's descriptions what he considered to be the most significant differences between *C. sessaei* and *E. spathacea* or why he placed them in different genera. The only point in which they were actually contrasted was that *C. sessaei* was said to have axillary flowers, whereas those of *E. spathacea* were described as being in terminal clusters. When Grisebach (1845) transferred *C. sessaei* to *Gentiana*, he distinguished it from *G. spathacea* chiefly by its lacking paired bracts beneath the flowers, according to Don's description of this taxon.

Don (1837) also described *Coilantha mocinni*, which was said to differ from *C. sessaei* in that it did have paired bracts beneath each flower. His description of *C. mocinni* as having 5-nerved, ovate-lanceolate leaves and a spathaceous calyx, and his statement that it, too, had been identified as *G. coerulea* Sessé & Mociño in Lambert's herbarium, indicate that it was also based on a specimen of *G. spathacea*, perhaps another specimen from the collection on which the name *C. sessaei* had been based. No specimen appropriate for the typification of the name *C. mocinni* could be found in BM, G, or OXF. Grisebach's (1845) treatment of this name as a synonym of *G. caliculata* Lex. was based only on Don's description of *C. mocinni* and was evidently due to Grisebach's admitted unfamiliarity with *G. caliculata*, of which he had then seen no specimens. Certainly the elements of

the description of *C. mocinni* noted above are inapplicable to *G. caliculata*.

To discuss the status of these segregates, it is necessary to consider the nature of the inflorescence of *G. spathacea*, which is basically a dichasial cyme. Within *G. spathacea*, there is a trend toward condensation of the inflorescence. Plants at one end of this trend have the entire inflorescence relatively open, so that at least the lower flowers may appear to be pedicellate and to be subtended only by "leaves," with no small bracts being present. In other plants, the pedicels, cyme branches, and upper internodes are very short or obsolete, and the leaves and bracts in the inflorescence are much reduced. In the most extreme expression of this trend, the inflorescence is more or less capitate, with the inner (theoretically upper) bracts, or some of them, minute or obsolete. Within a single population of *G. spathacea*, a wide range of variation in condensation of the inflorescence may be encountered. Small plants in the driest, most exposed microhabitats generally have small, terminal, capitate inflorescences, whereas plants in moister, more shaded sites are likely to have more longated inflorescences, with flower clusters or short flowering branches arising from several of the upper axils of the main stems. Otherwise, there is little obvious correlation between microhabitat and inflorescence form. Obviously, minor variation in such features as the length of cyme branches and pedicels, or the development of bracts, does not constitute a sound basis for taxonomic division of *G. spathacea*.

Martens & Galeotti (1844) segregated a solitary-flowered individual or individuals of *G. spathacea* with relatively broad leaves as *G. ovalis*. The solitary flower can almost certainly be attributed to the age of the plant or to adverse growing conditions. Leaf shape is variable within populations of *G. spathacea* and is evidently related to environmental factors. Plants in dry, sunny situations have relatively narrow leaves, which have a tendency to be ascending and somewhat conduplicate. Leaves of plants in moister, shadier sites, especially those leaves below the inflorescence, are proportionately wider, wide-spreading, and flat. The leaves of the type specimen of *G. ovalis* do not significantly exceed the range of variation in leaf shape commonly found in populations of *G. spathacea*.

An unnamed variant of *G. spathacea* was described by Bentham (1840) as having larger calyx teeth and frequently entire corolla appendages. This variant was given formal taxonomic status as *G. spathacea* var. *benthamii* ("*β Benthami*") by Grisebach (1845). Later, Kusnezow (1894) described var. *integra* as having an uncleft calyx with unequal, subulate teeth. (The calyx tube of var. *benthamii* was not described by Bentham or Grisebach but was evidently assumed by Kusnezow to have been cleft.)

Variability in calyx form exists throughout the range of *G. spathacea*. The type specimen of var. *benthamii* was collected in the vicinity of Real del Monte, Hidalgo, an area from which many specimens of *G. spathacea* have been obtained, most of them having the typical spathaceous calyces with minute lobes. Specimens approaching both extremes of variation, with

calyces ranging from hyaline and deeply cleft, with minute lobes, to herbaceous and uncleft, with lobes up to 6.5 mm long, may sometimes be found within a single collection, e.g., *Hinton 524* (US), from Temascaltepec, México, *Hinton et al. 13540* (F, GH, MICH, MO, NY, US) from the vicinity of Zitácuaro, Michoacán, or *Hinton et al. 15749* (DS, F, MEXU, NY, POM, UC, US), from Barroloso, Michoacán. There appears to be a trend toward less frequent and less extreme cleavage of the calyx tube and reduction of the calyx lobes in the western part of the range of *G. spathacea*, but plants from as far west as the vicinity of Autlán, Jalisco, exhibit considerable variation in these traits, even among the plants from a single population (*McVaugh et al. 10285* and *21320*, MICH). Except that large calyx lobes are generally associated with shallowly cleft or uncleft calyx tubes, the traits by which var. *benthamii* and var. *integra* were distinguished do not appear to be correlated with other morphological features. Neither the corolla lobes nor the free portions of the appendages of the holotype and isotype specimens of var. *benthamii* appear to differ appreciably from those of typical *G. spathacea*. Because of the sporadic occurrence of plants with relatively large calyx lobes and/or uncleft calyx tubes, formal taxonomic recognition of these variants seems to be unwarranted.

Plants collected in the vicinity of Pátzcuaro, Michoacán (*C.G. Pringle 3982*, MEXU, MSC, MU, NY, POM, UC, US, VT) are exceptional in that the stems had continued to elongate after the development of the lower axillary flower buds, so that, at the time of collection, clusters of flowers or buds, opening in acropetal sequence, were present in as many as 14 successive axils. *Moran 10075* (DS), from El Carmen, Hidalgo, has unusually large corollas for this species, ca. 5 cm long, with acuminate lobes ca. 10 mm long.

Gentiana spathacea is also variable in other, less conspicuous aspects. Plants in some populations have minutely papillose-puberulent stems, while plants in other populations have glabrous stems. (Most *Gentiana* species studied by me are consistent in having either puberulent or glabrous stems, but some, e.g., *G. saponaria* L., are similarly variable in this respect.) Within a single population of *G. spathacea*, one may encounter variation in whether the anthers are coherent or free; this variation may be correlated to some degree with the age of the flowers. Inrolling of the margins of the lobes of wilted or marcescent corollas may affect the superficial aspect of specimens prepared from such material.

The name *G. plicata* Willd. ex Schult. was not applied to a proposed segregate of this species but instead to the same collection that typifies the name *G. spathacea*, Schultes and Kunth having been working simultaneously on different sets of Humboldt's collections. In the present study, examination of photographs of the type specimen of *G. plicata* has confirmed that Humboldt et al. (1823) were correct in treating this name as a synonym of their own *G. spathacea*.

5. GENTIANA LAEVIGATA Mart. & Gal., Bull. Acad. Roy. Sci. Bruxelles 11(1):370. 1844. Type: MEXICO: Oaxaca: Cordillera, Sierra, 5-7000 [Paris ft], *Galeotti 1481*, Nov-Apr 1840, G, photos in F!, MICH!, NY! (duplicates may be elsewhere). Fig. 8.

Tap root, if present, 2.5-5 mm thick, usually accompanied or replaced by several well-developed secondary roots. Stems 1-6, at least the basal portions decumbent, the distal portions varying from flexuous to erect, 1.5-5(-9) dm long, minutely but copiously papillose-puberulent below, sparsely papillose-puberulent to smooth above. Stems and leaves usually much suffused with reddish-purple. Lower leaves, or nearly all the leaves on short stems (exclusive of reduced leaves near soil line), lanceolate to oblong, nearly flat and widely spreading to moderately conduplicate and arcuate, with 1 or 3 prominent veins, 1.5-5 cm long, 3.5-6.5 times as long as wide, obtuse to subacute at apex, abruptly tapering at base. Lower internodes 0.8-3 cm long. Upper leaves similar in shape but increasingly conduplicate and arcuate, 1.5-3 cm long. Upper internodes of well-developed stems 4-9 cm long. Involucral leaves subtending terminal flower cluster in 1 or 2 pairs, lanceolate to ovate, 2-3.5 cm long, (3-)8-14 mm wide, acute at apex, abruptly tapering to strongly rounded at base, strongly conduplicate, arcuate, enveloping the lower part of flower cluster. Leaf margins entire, revolute. Flowers solitary or in clusters of 2-6, confined to the terminal cluster or also borne on short (up to 2.5 cm), peduncle-like branches from uppermost 1-4 nodes. Individual flowers subtended by linear bracts usually 10-15 mm long, occasionally larger and foliaceous. Calyx tubes typically uncleft, 7-12 mm long, glabrous, the portions enveloped by the involucral leaves often somewhat hyaline. Calyx lobes erect or nearly so, typically linear-subulate to narrowly oblong, 2.5-8 mm long, 0.2-2 mm wide, acute. Calyces of occasional plants deeply cleft, with greatly reduced lobes. Corollas (2.5-)3-4 cm long, tube urceolate-cylindric, gradually expanding upward. Corolla lobes spreading, ovate-triangular, 3.5-7 mm long, as wide or slightly wider than long, minutely erose-serrate to nearly entire, obtuse or occasionally apiculate, sinuses subequal. Free portions of appendages asymmetrical, consisting of 2 nearly equal, attenuate teeth each 1.5-2 mm long and 0.5-1.2 mm wide, and an erose shoulder 1.8-3 mm wide extending to outer edge of the next lobe clockwise. Lower half of corolla tube whitish, tube increasingly suffused with blue upward, uppermost part of the tube, the lobes, and the free portions of the appendages deep blue throughout. Exterior surface of corolla with purplish suffusions as in *G. spathacea*. Blue pigment extending downward on interior surface of tube as prominent stripes between central and lateral petal veins. Stamen filaments becoming free at ca. 2/5 the height of corolla tube, free portions 10-12 mm long. Anthers loosely connate or free. Summit of ovary about even with tips of marcescent corolla in mature fruit. Seeds ca. 1.8 mm long and 0.8 mm long and 0.8 mm wide, winged, wing very narrow along one side.

Gentiana laevigata is evidently endemic to the Sierra Madre del Sur in Oaxaca, and to Los Altos, a subdivision of the Chiapas-Guatemala Highlands

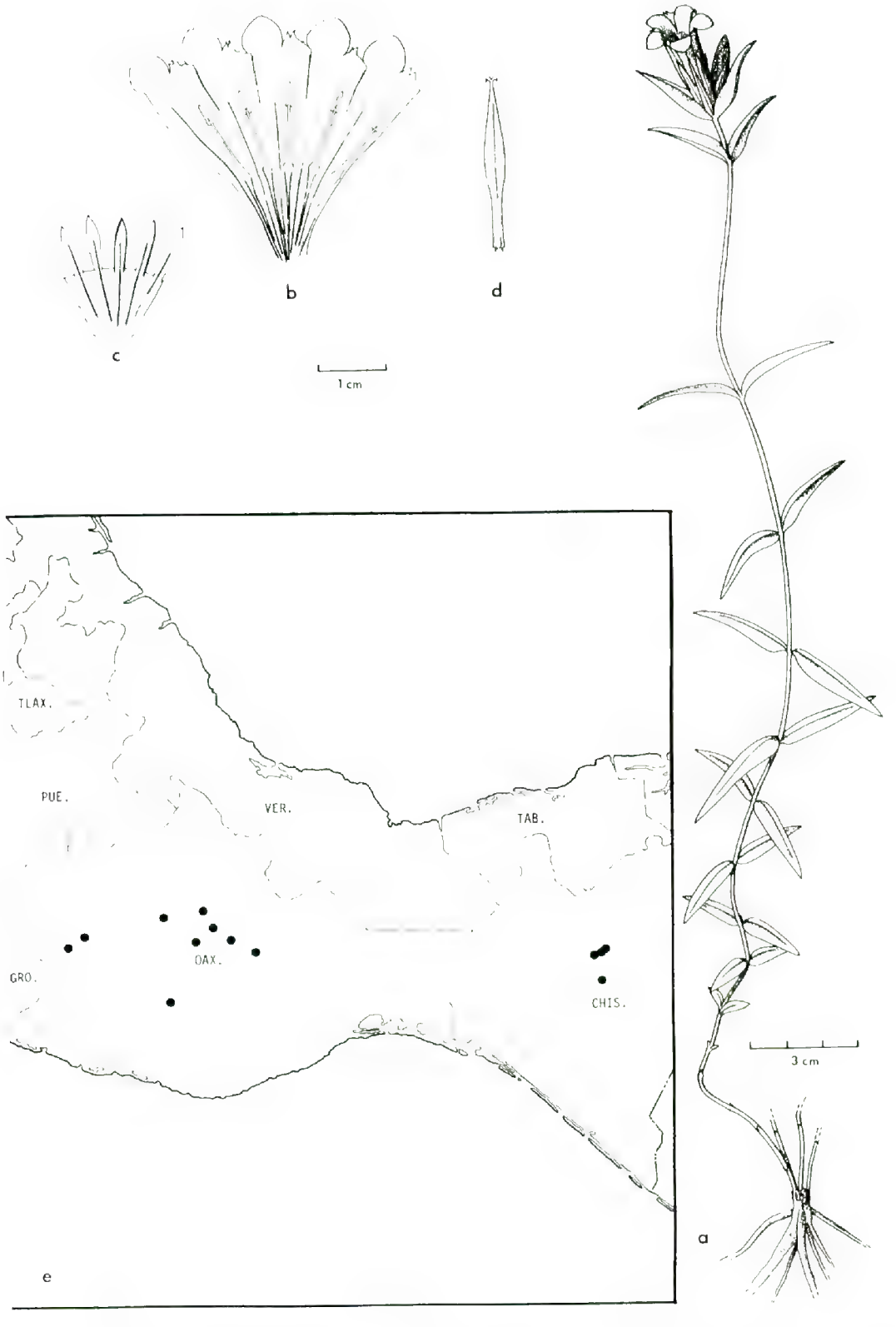

Fig. 8. *Gentiana laevigata.* a, flowering stem; b, interior surface of corolla, and c, exterior of calyx, slit longitudinally and pressed; d, pistil; e, documented distribution.

in Chiapas (Fig. 8e). Its usual habitat consists of grassy slopes in the pine-oak zone and in the lower portions of the cloud forest. Flowering occurs from August through February.

Representative specimens examined:

MEXICO: Chiapas: between Las Casas and Ejido "El Triunfo," *Sharp 45994* (MEXU, NY, TENN); barrio of Tuk, paraje of Matsab, Municipio of Tenejapa, *Breedlove 12443* (DS, F, MICH); 9 mi SE of San Cristóbal Las Casas, *Breedlove & Raven 13421* (DS, F); near Zinacantán center, *Laughlin 2705* (DS, US). Oaxaca: Santa Inés del Monte, *Conzatti 1348* (GH, MEXU); near Tlaxiaco, *Camp 2264* (NY); halfway from Guelatao to Llano de las Flores, *Vilas 332A, 332B* (WIS).

Gentiana laevigata is represented by relatively few collections. It occurs in small, widely scattered populations that exhibit some local differentiation in morphological traits. The majority of specimens, however, including all those cited above, are very similar to one another and to the type specimen. These specimens, therefore, were regarded as being most representative of *G. laevigata* in the preparation of the description of this species.

Gentiana laevigata appears to be a derivative of *G. spathacea* or its immediate ancestor, which became established in southern Mexico after orogenic processes had created suitable habitats. Its range in the mountains of Oaxaca and Chiapas is isolated from that of *G. spathacea* by the intervening lower and drier Mixtec Upland.

Gentiana laevigata and *G. spathacea* differ most conspicuously in their general habit and foliage. The stems of *G. spathacea* are relatively stout and are ascending to erect, or decumbent only near the base. Mature plants growing in favorable sites usually produce many stems. The stems of *G. laevigata*, in contrast, are slender and often flexuous, *Laughlin 2705* (DS, US) having been described as a "vine," and seldom number more than three or four per plant. *Gentiana spathacea* is usually densely leafy, whereas the upper leaves of *G. laevigata* are widely spaced. Also, the leaves of *G. laevigata* are proportionately wider than those of *G. spathacea*. The upper leaves of *G. laevigata* are generally somewhat arcuate and strongly conduplicate, in contrast to those of *G. spathacea*, which are not arcuate and seldom strongly conduplicate except in sun forms.

The corolla lobes of *G. laevigata* are broadly deltoid-ovate, and the apices are usually obtuse or rounded. Thus they contrast with the elliptic, strongly apiculate corolla lobes of *G. spathacea*. Also, the free portions of the corolla appendages of *G. laevigata* are definitely asymmetrical, consisting of two teeth and an erose "shoulder," whereas those of *G. spathacea* are nearly symmetrically divided into two teeth only. *Gentiana laevigata* differs further from *G. spathacea* in its proportionately longer stamens.

Both *G. laevigata* and *G. spathacea* are variable in calyx form. Typical plants of *G. laevigata* differ from those of *G. spathacea* in having uncleft calyces with well-developed, subequal lobes. Occasional plants of *G. laevigata*, e.g., *C.G. Pringle 5647* (GH, MICH, VT), collected near Las Sedas,

Oaxaca, differ from the typical form of this species in having cleft calyx tubes. *Ghiesbreght 718* (MO), from the vicinity of San Cristóbal Las Casas, Chiapas, and *MacDougall 2616* (NY), collected between La Cumbre and Ixtlán de Juárez, Oaxaca, include flowers with cleft and uncleft calyces on the same sheet.

Specimens collected between Tamazulapa and Ayutla, Oaxaca (*Camp 2725*, NY) exhibit unusual branching and have proportionately wider leaves than are commonly encountered in *G. laevigata*, although the flowers are entirely characteristic of this species. On one of the plants in this collection, there are three slender branches 1-1.5 dm long, plus several leafy tufts, borne near the base of the main stem, in addition to branches up to 3 cm long from the upper five axils. The branches terminate in clusters of relatively small flowers. Another plant on the same sheet has branches ca. 1.5 cm long from the upper three axils only.

6. GENTIANA CALICULATA Lex. in La Llave & Lex., Nov. Veg. Descr. p. 18. 1824. Type: MEXICO: [Michoacán]: prope Santa María, oppidum indianum juxta Vallisoletum, no further collection data, not located, probably not extant. (Ex char.) Neotype (hoc loc.): MEXICO: [México]: in sylvis prope Temascaltepec, *Ehrenberg s.n.*, no date (probably Apr 1831), MEXU! Fig. 9.

Gentiana salpinx Griseb., Linnaea 22:44. 1849. Type: MEXICO: [México]: in sylvis prope Temascaltepec, *Ehrenberg 450*, Apr 1831, holotype formerly in B, probably not extant; neotype of *Gentiana caliculata*, cited above, is probably an unnumbered duplicate of the same collection; other duplicates may be elsewhere.

Root system comprising several subequal, fleshy roots (according to Lexarza, in La Llave & Lexarza, 1824). Stems 1-few, ascending to erect, 0.4-1.6 m tall, minutely papillose-puberulent. Lower leaves (except for scalelike leaves near soil line) ovate to elliptic, flat, 3-5-nerved, 3-9 cm long, 1-4 cm wide (length/width ratio variable), acute at apex, rounded at base, often marcescent at flowering time. Lower internodes 2-3 cm long. Median leaves smaller and more distantly spaced, elliptic-oblong, flat to moderately conduplicate, 1-3-nerved, acute at apex, truncate at base. Upper leaves linear, strongly conduplicate and arcuate, 1-nerved, 1.5-5 cm long, 1-6 cm wide, acute to acuminate at apex, tapering at base. Upper internodes usually 5-15 cm long. Leaf margins entire, revolute. Cymes terminal and on short (or occasionally elongate, up to 1.5 dm long) branches from the upper 2-8 nodes, the branches often arching toward tip, the two branches arising from opposite sides of the same node usually being curved in the same direction, the inflorescence, or at least its lower part, thus being more or less secund. Flowers solitary or in small, dense clusters (often in pairs), individually short-pedicellate or sessile. Cymes, their divisions, and individual flowers subtended by linear strongly arcuate and conduplicate, acuminate, minutely ciliolate bracts, those subtending cymes usually 2-3 cm long, 2-4 mm wide, those subtending individual flowers or pairs of flowers 1-2 cm long, 1-2 mm

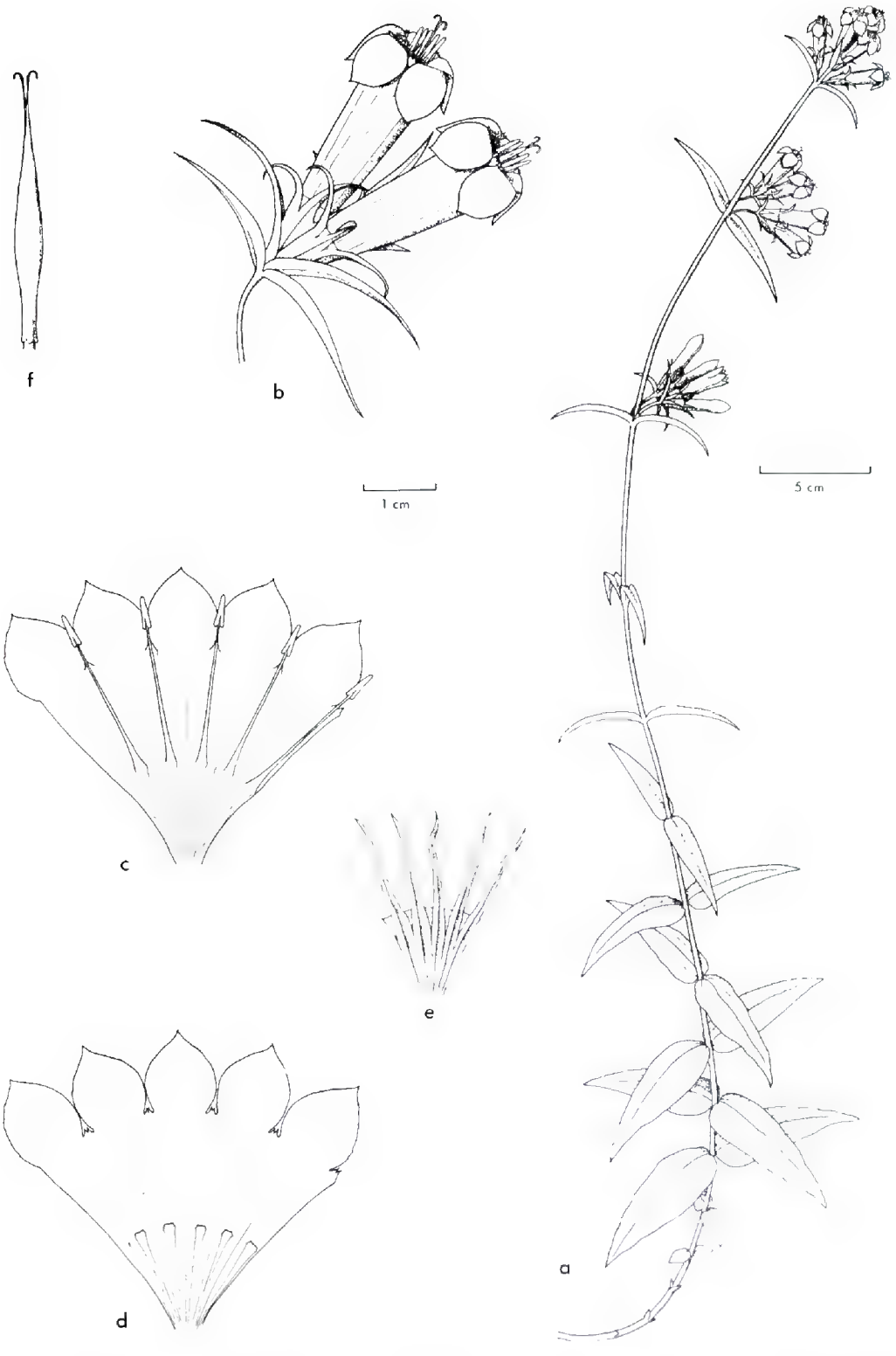

Fig. 9. *Gentiana caliculata*. a, flowering stem; b, a pair of flowers with subtending bracts; c-d, interior surfaces of corollas, with stamens present (c) and stamens removed (d), and e, exterior surface of calyx, slit longitudinally and pressed; f, pistil.

wide. Calyx tubes uncleft, 6-16 mm long, minutely but copiously puberulent. Calyx lobes linear, strongly arcuate-recurved, 6-20 mm long, puberulent and ciliolate. Corolla tubes 2.5-4 cm long, flaring just above summit of calyx tube, otherwise nearly cylindrical. Corolla lobes reflexed, 6.5-15 mm long, oblong-ovate to nearly orbicular, apiculate, margins often erose-serrate, especially near base, sinuses subequal. Free portions of appendages consisting of 2 approximately equal, acuminate to attenuate teeth each 1.5-2 mm long and ca. 1 mm wide, usually largely concealed by lobes. Lower 1/3 of corolla tube, lobes, and free portions of appendages crimson throughout, interior surface with small yellowish-green spots on lower portion of lobes and adjacent portions of tube, the red pigment extending downward along veins and as spots or short streaks on interior surface between central and lateral petal veins. Stamen filaments becoming free a little below middle of corolla tube. Anthers free, the tips reaching nearly to the level of tips of the corolla lobes of unopened or pressed flowers, the anthers thus being exserted 6-9 mm from mouth of intact corollas with reflexed lobes. Pistil with ovary tapering upward into a distinct, slender style, which bifurcates below the stigmatic surfaces, the stigmas being exserted 2-10 mm beyond mouth of corolla tube, and with the non-placental zones adjacent to the sutures relatively wide, otherwise typical of the section. Both anthers and style branches spiraling in age. Fruit slightly exserted at maturity. Seeds ca. 2 mm long, 0.4 mm wide, prominently winged at one end, wing otherwise narrow but complete.

Gentiana caliculata is endemic to a region comprising the western portion of the Neovolcanic Plateau, from Morelos west to Jalisco, and extending south to the Sierra Madre del Sur in Guerrero (Fig. 10). Here it grows on grassy slopes in the pine-oak zone, flowering from March through June.

Representative specimens examined:

MEXICO: Guerrero: Puerto Rico, *Hinton et al. 14169* (DS, F, GH, MEXU, MICH, NY, POM, UC, US, WTU). Jalisco: Nevado de Colima, *C.G. Pringle 5513* (GH). México: Rincón, *Hinton 11201* (CU, F, GH, ILL, MO, NY, TEX, US, WTU). Michocán: Sierra Torrecillas, *Hinton et al. 13690* (ENCB, GH, NY, US). Morelos: near Cuernavaca, *C.G. Pringle 7767* (MEXU, VT).

No type specimen for the name *G. caliculata* Lex. has been located, and it is extremely unlikely that any such specimen exists. The only herbarium known to contain specimens collected by La Llave & Lexarza prior to the publication of their *Novorum Vegetabilium Descriptiones* is that of the Conservatoire et Jardin Botanique, Genève (G) (Chaudri et al., 1972; R. McVaugh, personal communication). According to information graciously supplied by Dr. M. Dittrich, *G. caliculata* is not represented among the La Llave & Lexarza collections there.

The only other herbarium known to house La Llave collections is that of the Botanische Staatssammlung, München (M), at which there are four specimens of Mexican gentians collected by La Llave in 1830, after the *Novorum Vegetabilium Descriptiones* had been published. These include one specimen

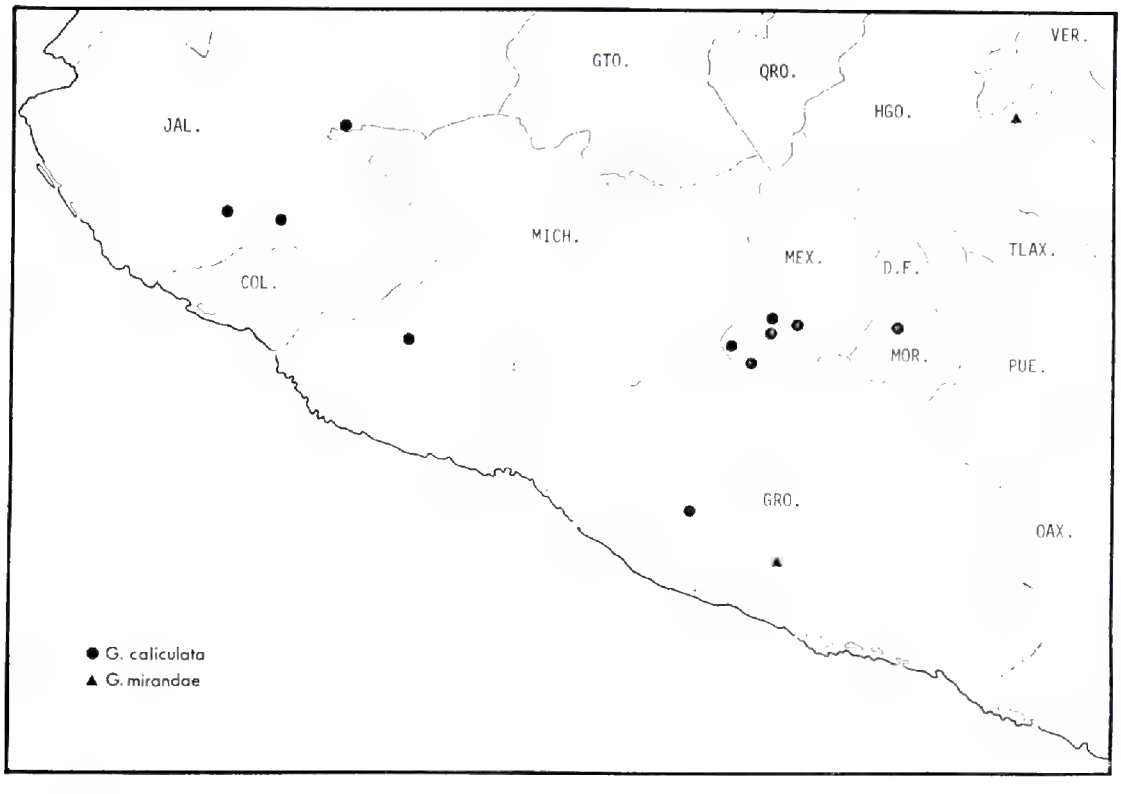

Fig. 10. Documented distribution of *Gentiana caliculata* and *G. mirandae*.

of *Gentiana bicuspidata* and two of *G. spathacea*, all from Angangueo, Michoacán, and one of *Gentianella amarella* (L.) Börner ssp. *hartwegii* (Benth.) J.M. Gillett, from Las Cruces, Distrito Federal. Since none of these specimens was identified to species by La Llave, they do not indicate to what species La Llave & Lexarza applied any of the new specific names published by them.

In the absence of a type specimen for the name *G. caliculata* Lex., whether this species is the same as *G. salpinx* Griseb. has long remained in doubt. Specimens have generally been filed under the name *G. salpinx* in herbaria, but some collectors and curators, including C.G. Pringle and, more recently, E. Matuda and L.B. Smith, have called this species *G. caliculata*.

The type specimen of *G. salpinx* had been labeled "*Gentiana calyculata*" [sic] by Ehrenberg, according to Grisebach (1849) and Bullock (1935), as had the probable replicate in MEXU. Ehrenberg did not indicate whether he had identified these specimens as *G. caliculata* on any basis other than that of Lexarza's (in La Llave & Lexarza, 1824) published description of this species. However, since Ehrenberg was a contemporary of Lexarza's colleague, La Llave, in Mexico, was acquainted with the leading authorities on the Mexican flora at the time, and traveled quite widely in Mexico (Urban, 1897), the possibility that he had some further basis for the identification of

this collection seems not unlikely. Accordingly, I have selected an extant replicate of this Ehrenberg collection as the neotype of *Gentiana caliculata* Lex.

Although Grisebach (1849), Kusnezow (1894), and Bullock (1935) all assumed that *G. caliculata* Lex. and *G. salpinx* Griseb. were different species, each of these authors admitted to being acquainted only with the latter. This assumption appears to have been based almost entirely on Lexarza's (in La Llave & Lexarza, 1824) description of the corolla of *G. caliculata* as being "calyce paulo longior." In all other respects, Lexarza's description of *G. caliculata* appears to constitute an accurate and relatively detailed description of the species subsequently called *G. salpinx*. No other gentianaceous species having red corollas with reflexed lobes, exserted anthers, and the other traits attributed to *G. caliculata* by Lexarza is known from the vicinity of Morelia (formerly Valladolid, latinized Vallisoletum) in Michoacán. Consequently it appears virtually certain that the name *G. caliculata* was applied to the same species as the later name *G. salpinx*, despite the presence of the one discordant element pertaining to the relative lengths of the calyx and corolla in the original description of *G. caliculata*.

A number of authors on pollination ecology, notably Grant & Grant (1968), have observed that certain floral features are commonly associated with hummingbird pollination, especially in North America. Some of these traits, such as the prolonged corolla tube, the abundance of nectar, and the elevation of the ovary above the nectar by a gynophore, prevail throughout sect. *Pneumonanthe* and in much of the genus *Gentiana*. It seems likely, therefore, that other Mexican species of *Gentiana* may occasionally be visited by hummingbirds, although the effectiveness of these birds as pollinators is doubtful. In *G. caliculata*, however, there are a number of floral traits that appear to be specific adaptations to pollination by hummingbirds. These include the red corolla; the reflexed corolla lobes, which eliminate a landing platform that might be used by insects; the exserted anthers and stigmatic lobes; and the deviation of the flowers from the strictly vertical position prevailing in the genus.

The relationships of *G. caliculata* are obscured by the modifications of floral structure involved in the "hummingbird-pollination syndrome." The red corolla, the relatively long style, and the frequent presence of well-developed branches within the cyme are distinct departures from the prevalent morphology of sect. *Pneumonanthe*. The vegetative portions of *G. caliculata*, especially with smaller plants, do, however, resemble those of *G. laevigata*, and the free portions of the corolla appendages are similar to those of certain species in sect. *Pneumonanthe* native to the Pacific Coastal regions of northern North America and northern Asia, such as *G. platypetala* Griseb. and *G. sikokiana* Maxim. These features, along with the bracteation of *G. caliculata* and its relatively short and stout gynophore, indicate that this species is correctly placed in sect. *Pneumonanthe*.

7. GENTIANA MIRANDAE Paray, Bol. Soc. Bot. México 21:15. 1957. Type: MEXICO: Guerrero: faldas del cerro Tlacotepec, Mpio. Tlacotepec, *Paray 2013*, 30 Mar 1956, holotype MEXU! isotype ENCB!, photos HAM! Fig. 11.

Tap root persistent, long and slender (ca. 4.3 mm in diameter at summit and 4 dm long, with 1 fork, in *Pringle 1753*). Stems 1-3, arching or extending nearly horizontally from steep slopes (as seen in Hidalgo) to erect (as described by Paray, 1957), 2-9 dm long, with short, peduncle-like branches from upper 1 or 2 nodes, the longer stems also with short leafy branches from lower nodes, minutely papillose-puberulent in lines near nodes, otherwise glabrous, often suffused with purple. Leaves medium to dark green, sometimes suffused with purple, lanceolate to ovate, lower ones obtuse to acute, upper ones acute to acuminate at apex, rounded at base, those between the middle of the stem and base of inflorescence largest, 3-8 cm long and 1.8-3.5 times as long as wide, with 3 or 5 prominent veins. Lower leaves gradually smaller, the lowest mere scales. Leaf margins minutely denticulate, very narrowly revolute except sometimes near base. Upper 2-5 internodes 2-7 cm long, lower ones gradually shorter. Flowers occasionally solitary, usually in terminal, sometimes imperfectly developed, cymes of 3-5, and sometimes also solitary or paired at ends of short branches from the first 1-6 nodes below the terminal cymes, the 2 flowers borne on opposite cyme branches or terminating the same branch reaching anthesis asynchronously. Each flower subtended by a pair of linear to lanceolate bracts 1-3.5 cm long. Calyx tube uncleft, 7.5-20 mm long, 5-ridged, glabrous. Calyx lobes erect, linear to oblong, 6-14 mm long, 1-2 mm wide, narrowly carinate, abruptly acuminate, with margins minutely denticulate proximally, entire distally. Corolla tube cylindric, 4.5-7.5 cm long, 8-12 mm in diameter. Corolla lobes erect to slightly divergent, ovate-triangular, 4-6 mm long and about as wide as long, entire, acute to acuminate, the sinus adjacent to outer edge of each lobe slightly lower than the other. Free portions of corolla appendages obliquely triangular, ca. 2 mm long, acute, entire or sparingly erose. Corolla tube above summit of calyx tube (except sometimes for lowest 1-10 mm), along with lobes and free portions of appendages yellow in bud, orange-red at anthesis, becoming scarlet, then purplish brick-red when the stigma is receptive. Corolla tube not striped on interior surface. Stamen filaments becoming free at 0.33-0.38 times length of corolla tube; free portions very slender, elevating anthers so that their tips approach or slightly exceed the level of the tips of corolla lobes. Anthers ca. 3.5 mm long, not cohering. Ovary 1.8-3 cm long when stigma is receptive, elevated by a gynophore about the same length. Style deeply 2-cleft, the divisions slender, continuing to elongate and coiling after anthesis (the flowers being strongly protandrous), the stigmatic surfaces exserted beyond tips of corolla lobes. Fruits and seeds not seen.

Gentiana mirandae is known only from the type collection (from Guerrero) and from the three collections from one Hidalgo locality cited below,

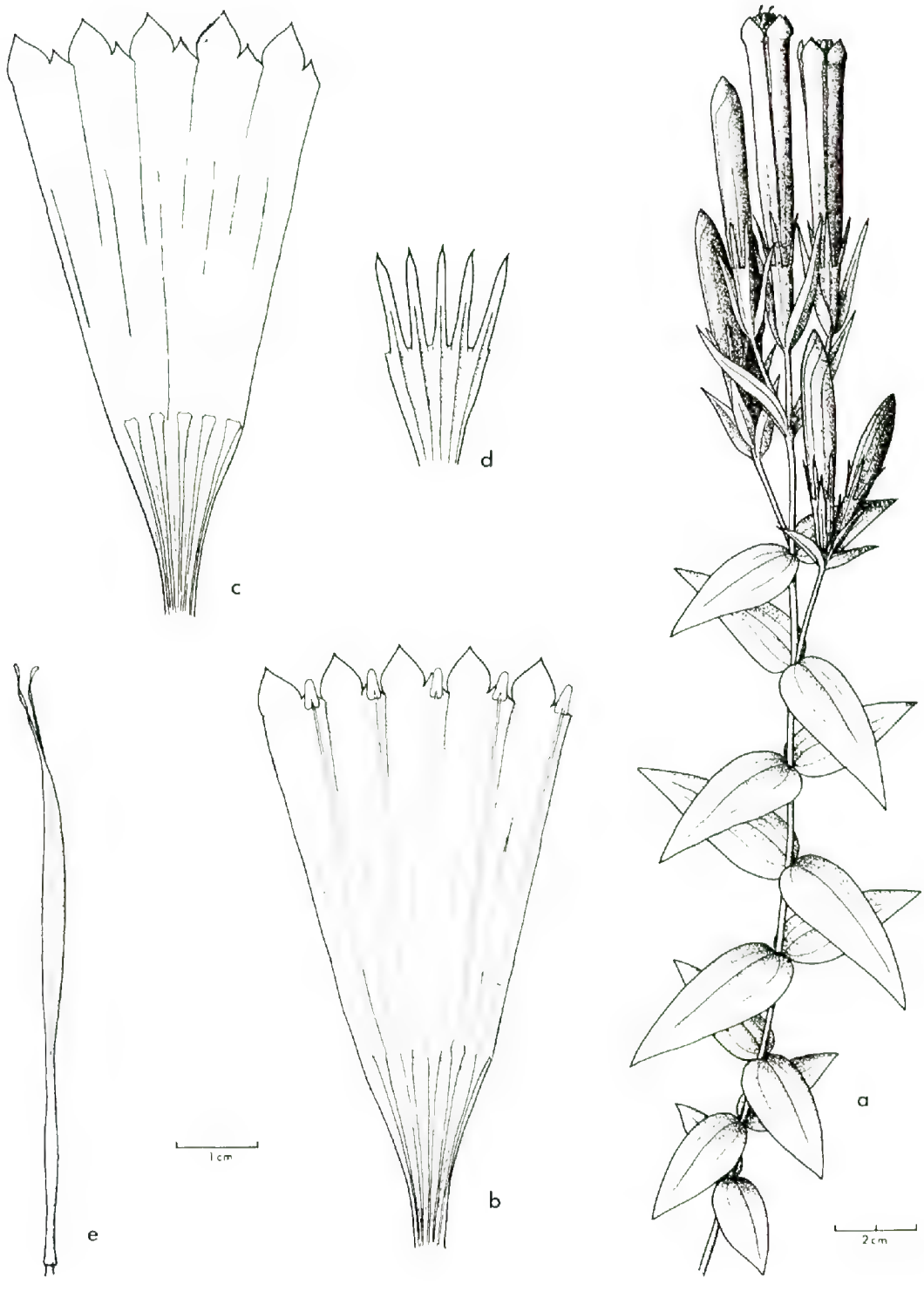

Fig. 11. *Gentiana mirandae*. a, flowering stem; b-c, interior surfaces of corollas, with stamens present (b) and stamens removed (c), and d, calyx, slit longitudinally and pressed; e, pistil.

which were identified during the present study (Fig. 10). The type collection was made in openings on wooded slopes with *Pinus* and *Alnus* dominant, at 2200-2500 m altitude, and those from Hidalgo on a steep, rocky roadside bank in *Pinus-Alnus* woods about 2100 m. All four collections were made in March, at which time the plants were in full bloom.

Additional specimens examined:

MEXICO: Hidalgo: El Estribo, carretera Tulancingo-Tenango, km 42, *Gimate L. 509* (ENCB); carretera Tulancingo-Tenango, km 44, *Gimate L. 542* (ENCB); 18.4 km by road NE of Metepec on road to Tenango de Doria, *J.S. Pringle 1753* (HAM, MEXU, pollen SPN).

Like *G. caliculata*, *G. mirandae* appears to be adapted to pollination by hummingbirds, as it, too, has long-tubed, red corollas and exserted anthers and stigmatic lobes. Its corolla lobes, although erect rather than reflexed, likewise fail to provide a landing platform. The branching pattern of *G. mirandae*, its corolla shape and color, and its elongate gynophore, which is unique among species in sect. *Pneumonanthe*, give this species an aspect similar to that of certain species in the Asiatic sect. *Stenogyne* Franch. The carpels of *G. mirandae*, however, have seven vascular bundles each, with the ovules being distributed over much of the interior surface, and thus conform to the pattern of ovarian anatomy reported for sect. *Pneumonanthe* by Lindsey (1940) and differ from that of sect. *Stenogyne*.

The disjunction in the known range of *G. mirandae* is not readily explicable, since pine-alder forests, which constitute the habitat of *G. mirandae* as far as is known, occur extensively between the stations of this species in Guerrero and Hidalgo. Although additional populations may be found in the future, it seems certain that *G. mirandae* is genuinely rare and widely disjunct in its occurrence. Some differentiation may exist between the Guerrero and Hidalgo populations, as indicated by Paray's (1957) description of the Guerrero plants as being erect and as having larger flowers than those seen in Hidalgo. Specimens from both regions, however, are so similar in details of leaf, calyx, and corolla morphology that their taxonomic separation would be unwarranted.

Interspecific hybrids

Although, in view of the extensive interfertility among species of sect. *Pneumonanthe*, it seems unlikely that the Mexican and Central American species are separated by barriers of incompatibility, hybridization among these species seems to be extremely rare. Some species are ecologically isolated from others; *G. ovatiloba*, for example, being virtually restricted to alpine habitats, rarely occurs in proximity to species growing at lower elevations. Genetic exchange among the species of the pine-oak of the Mexican mountains appears to be minimized by the tendency of these species to occur in small, scattered populations and by the fragmented distribution of the habitat itself.

Specimens cited above as examples of variation within one species in the direction of its nearest Mexican relative should probably not be considered to represent the results of interspecific hybridization. Some of these specimens may simply represent intraspecific variability that by chance happens to result in similarity to a related species in one or two traits. Others may represent patristically intermediate populations persisting in isolated, relatively stable habitats as remnants of ancestral complexes that existed before the differentiation of present-day species was complete.

True hybridization between well-differentiated species of *Gentiana* in Mexico appears to be represented only by a series of collections by L. Paray, from the vicinity of Contreras, Distrito Federal, mapped in Fig. 6g. *Paray 1247* (ENCB) and two of the stems in *Paray 1248* (ENCB) are typical of *G. spathacea*. *Paray 1249* (ENCB), from the same area, represents *G. bicuspidata*, with some of the specimens on this sheet showing evidence of hybridization. *Paray 3451* (DS, ENCB, MEXU, MICH, MSC) and the remaining components of *Paray 1248* are collections of evident hybrids between *G. bicuspidata* and *G. spathacea*, as Paray suspected in the case of *3451* (in sched.). These specimens have decumbent to ascending stems 2-4 dm long, some bearing small, leafy branches or tufts in some of the leaf axils. The leaves are ovate, the larger ones 2.2-4.5 cm long, 2.5-3 times as long as wide, with the apices of the lower leaves obtuse, those of the upper leaves varying from obtuse to acute. The flowers are borne in small terminal clusters and singly at the ends of peduncle-like branches up to 30 mm long, the branches usually in pairs, but one member of the pair sometimes terminating in an abortive flower only. The flowers are individually subtended by ovate bracts 12-20 mm long. The calyces are uncleft, with broadly linear to ovate-oblong lobes 4-7 mm long. Corolla length ranges from 2.7-3 cm on one stem to ca. 4 cm on another. The corolla lobes are orbicular or nearly so, 4-6 mm long, obtuse or minutely apiculate. The free portions of the appendages are bicuspidate. *Paray 367* (ENCB), from the Sierra de Las Cruces, about 10 km to the west of Contreras, consists of highly similar plants that are probably of the same origin.

Unconfirmed Report

The range of *Gentiana affinis* Griseb. in Hook., Fl. Bor.-Am. 2:56. "1840" [1837] was said to extend from British Columbia and Alberta south to California, Arizona, and northern Mexico by Hitchcock (1959). No specimens were located during the present study that would substantiate this report of *G. affinis* from Mexico. There are specimens of *G. affinis* (as *G. interrupta*, a taxonomically insignificant variant of this species) and *G. parryi* A. Gray in F, collected by Brother G. Arsène et al. in 1926, that bear labels with the printed heading "Plantes du Mexique." The handwritten locality data, "Las Vegas," however, doubtless refer to Las Vegas, San Miguel County, New Mexico, where Arsène is known to have collected plants in 1926 (Ewan, 1950), rather than to a Mexican locality.

Kearney et al. (1942) have reported *G. affinis* (as *G. bigelowii*, another minor variant) occurring as far south as Cochise and Pima counties in southeastern Arizona. *Gentiana affinis*, therefore, might be expected in the Sierra de San Bernardino and the Sierra de San Luís in adjacent northeastern Sonora.

Detailed descriptions of *G. affinis*, accompanied by illustrations, have been published by Hitchcock (1959) and by Gillett (1963).

ACKNOWLEDGMENTS

I express my sincere thanks to: the curators and staff of the herbaria listed in the introduction of this paper, for the loan of specimens or for their hospitality and cooperation during my visits to their institutions; to those at B, K, M, and OXF, for supplying photographs of nomenclaturally important specimens; to the Consejo Nacional de Ciencia y Tecnología, for permission to collect specimens of *Gentiana* in Mexico; to Drs. John M. Gillett and Rogers McVaugh, for their reviews of a preliminary version of the manuscript, and for valuable information and suggestions; to Dr. Thomas Duncan, for his cooperation and assistance with field work; and to the Board of the Royal Botanical Gardens, for its contributions to the support of the research and to the publication of this paper.

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NOTES

JUVENILE LEAVES IN OKLAHOMA *MARSILEA* (MARSILEACEAE)—During June 1973, while teaching at the University of Oklahoma Biological Station, I collected specimens of *Marsilea* that were unusual, at least to me, because of the diversity of form exhibited by their leaves. Long a subscriber to—and a teacher of—the maxim that *Marsilea* leaves are quadrifoliolate, I was surprised to see simple, bilobed, trilobed, and other unexpectedly-shaped leaves as well as "normal" quadrifoliolate ones. The present note and illustration call attention to the unusual leaves, which apparently are seldom seen.

The plants, collected 21 June 1973, were rooted in the muddy bottom of a clearwater pond about 1 mile north of Headquarters, Tishomingo National Wildlife Refuge, Johnston County, Oklahoma. Growing with them were *Chara, Typha* seedlings, *Potamogeton diversifolius, P. nodosus, Najas guadalupensis, Echinodorus rostratus, Elatine triandra,* and *Bacopa rotundifolia.* Water at the collection site was about 12 inches deep. The blades of the quadrifoliolate leaves—one per specimen—were floating; the petiole of each arose from a rhizome that was very shallowly covered with mud of the pond bottom. No rhizome I collected exceeded about 8 cm in length. The "unusual" leaves, arising each at a different node, were small, not over 1 cm long (including the petiole). Unfortunately, because I preserved only individual leaves after removing them from rhizomes, I do not know if leaf shape correlated with position on a rhizome.

These leaves were certainly "juvenile" leaves such as those described (pp. 74, 75) and illustrated (p. 37) by K. M. Gupta in his book *Marsilea* (Bot. Monogr. 2. Council of Scientific & Industrial Research, New Delhi, 1962). According to Gupta, new "sporelings" [i.e., sporophytes] are produced by germination of perennating organs "when the water in the ponds settles down to a suitable depth of two to three feet. As usual the young plants pass through the well-known [!] juvenile stages producing unifoliate, bifoliate, trifoliate, quadrifoliate submerged and finally the floating leaves characteristic of the genus."

Eames, in *Morphology of Vascular Plants. Lower Groups* (1936) wrote: "The earliest leaves of *Marsilea* are subulate, like those of *Pilularia*; then follow, in turn, spatulate; two-lobed, as in *Regnellidium*; four-lobed; and finally the four-leaflet type."

Later in the 1973 season, as water level in the pond fell, I collected typical *M. mucronata* A. Br. on the drying pond margin.—*John W. Thieret, Department of Biological Sciences, Northern Kentucky University, Highland Heights, KY 41076.*

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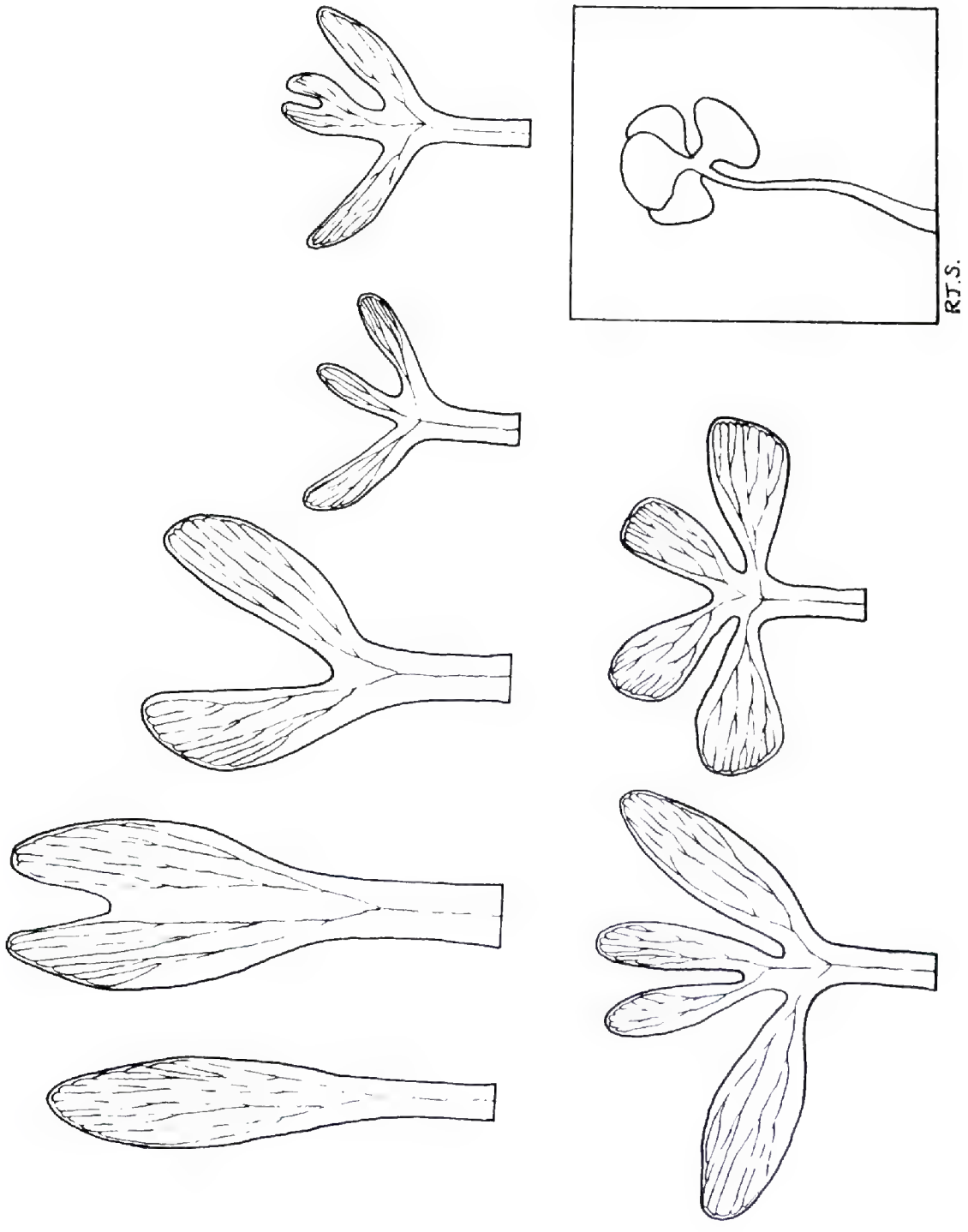

Figure 1. *Marsilea mucronata.* Upper row and lower left and center, juvenile leaves, 4X; lower right, in square, adult leaf, ½X.

AMMOSELINUM BUTLERI (UMBELLIFERAE), NEW TO NORTH CAROLINA—In early April of 1975 I collected an unfamiliar plant of the Umbelliferae. With the help of Dr. J. R. Massey, Curator of the University of North Carolina Herbarium, it was identified as *Ammoselinum butleri* (Engelm.) Coult. & Rose and represents a new addition to the flora of North Carolina. The previous range of this species is given by Mathias and Constance (1944-45) as Arkansas and Oklahoma to Texas. Correll and Johnston (1970) extended the range southward to Nuevo Leon and west to New Mexico.

In North Carolina the plant was found growing on a weed covered slope with several other plants which it superficially resembles: *Alchemilla microcarpa* Boiss. & Reut., *Soliva pterosperma* (Juss.) Less. and *Coronopus didymus* (L.) Smith.

To be certain that *Ammoselinum* was truly established the locality was revisited in the spring of 1976 by Emily Wood and it was found that the plants were not only as abundant as in the previous year but had in fact spread beyond their original boundaries.

Collection data for the *Ammoselinum* are as follows: Orange County, North Carolina. University of North Carolina campus, Chapel Hill. On weed-covered slope south of Kenan Stadium. Flowers white. Plants prostrate or reclining on other vegetation. *D. E. Boufford 15932*, 2 April 1975; Lawn behind Kenan Stadium, adjacent to Ram's Head Parking Lot. *E. W. Wood 2901*, 28 March 1976. Vouchers have been deposited at North Carolina University and duplicates will be distributed through the North Carolina University exchange program.— *David E. Boufford, Biology Department, Washington University, St. Louis, Missouri, 63130.*

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ADDITIONS TO THE LOUISIANA FLORA—During the late 1960's and early 1970's Thieret published several lists of additions to the Louisiana flora culminating in 1972 with a check-list of vascular plants through the monocots. Reported additions have been scanty since then except for Allen's addition of 19 grasses in 1974. The following note adds 16 new monocots, one definite and two tentative dicots. Lack of a complete check-list is a serious handicap to Louisiana collectors particularly those in the poorly covered northwestern section of the state.

Vouchers on all plants are in the herbarium of Louisiana State University

at Shreveport (LSUS). All were collected in Caddo Parish.

Sparaganium androcladum (Engelm.) Morong. Very uncommon; in ditch at Ellerbe and Fluornoy-Lucas roads, 7 miles south of Shreveport. July 6, 1976, *MacR. 1838.*

Agrostis gigantea Roth. (*Agrostis alba* of authors, not L.) Uncommon on shores of Cross Lake at State Fish Hatchery. July 5, 1976, *MacR. 1836.*

Anthoxanthum artistatum Bios. Locally scattered in sparse woodland on shores of small lake off Ellerbe road, 9 miles south of Shreveport. May 27, 1976, *MacR. 1742.*

Bromus macrostachys Desf. This oddly distributed species, previously reported from Yonkers, N.Y. and College Station, Texas (Hitchock, Gould) is not uncommon along a drainage ditch in Betty Virginia Park, Shreveport. June 12, 1976, *MacR. 1770.* Identified by Dr. Frank W. Gould.

Cynosurus echinatus L. Uncommon; local on Wallace Lake road about 1½ miles from Wallace Lake. An erratically distributed grass reported for Arkansas and Oklahoma by Hitchcock but not for Texas by Gould. June 13, 1976, *MacR. 1773.* Identified by Dr. Gould.

Elymus canadensis L. Common to abundant in roadside ditches, open fields and thin woods. Ellerbe and Norris Ferry roads, 9 miles south of Shreveport. June 6, 1976, *MacR. 1761.*

Vulpia bromoides (L.) S. F. Gray (*Vulpia dertonensis* (All.) Gola.) Common along shores of small lake off Ellerbe road, south edge of Shreveport. May 1, 1976, *MacR. 1684.*

Lolium temulentum L. Common in damp roadside ditches; Norris Ferry road at DeBroeck road, 13 miles south of Shreveport. April 25, 1976, *MacR. 1673.*

Sclerochloa dura (L.) Beauv. Eurasian grass widely introduced and established through the western states and in New York. Lawn of Willis-Knighton Hospital, Shreveport. Nov. 1, 1975, *MacR. 1596.*

Sorghum almum Parodi. Considered to be a hybrid, with *S. halepense* as one parent, it is now given specific rank by Gould. Single location but apparently persistent. Railroad siding at Forbing. Aug. 23, 1975, *MacR. 1466.*

Eleocharis acicularis (L.) R.&S. Common in shallow running water below dam on small lake off Ellerbe road, 9 miles south of Shreveport. Aug. 11, 1975. *Mac.R. 1438.*

Zebrina pendula Schnizl. var. *quadrifolia* Bailey. A common ornamental, escaped and growing with *Commelina* sp. in roadside ditch, Norris Ferry road, 9 miles south of Shreveport. July 2, 1976, *MacR. 1824.*

Trillium texanum Buckley has been reported from a few scattered locations in Texas (Nixon, Lewis & Freeman). It is considered a threatened, endemic species. We can now report an extension of its range into Louisiana. Very rare in low wet bogs, 2 miles southwest of Rodessa. March 23, 1977, *MacR. 2160.*

Hymenocallis caroliniana (L.) Herb. Dry sandy upland woods off Wallace Lake road. Probably a relic of cultivation but long persistent. July 8, 1976, *MacR. 1843.*

Dioscorea quarternata (Walt.) Gmel. Thieret shows this in synonomy with *D. villosa.* Following Correll & Johnston it is given species status. Common in dense woods along Bayou Pierre, south Shreveport. May 6, 1975, *MacR. 1189.*

Habenaria lacera (Michx.) Lodd. Rare in dense woods off Norris Ferry road, 9½ miles south of Shreveport, June 6, 1976, *MacR. 1759.*

Trifolium hirtum All. This weedy clover is widely but erratically distributed throughout the United States. It was not included in "Legumes of Louisiana" by Alex Lasseigne who identified the plant for me. Very locally abundant on Wallace Lake road about 1½ miles from Wallace Lake. April 26, 1974, *MacR. 1013.*

The following two species may not be new to Louisiana but are sufficiently outside their normal range to be noted:

Hieracium scabrum Michx. Found in a single location at south edge of East Ridge Country Club, south side of Shreveport. Aug. 13, 1976, *MacR. 1923.*

Monarda pectinata Nutt. A western species not expected east of western Texas. Uncommon on median strip of Clyde Fant Parkway, Shreveport. June 3, 1976, *MacR. 1753.—D. T. MacRoberts, Louisiana State University, Shreveport, 71115.*

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NEW COMBINATIONS IN MEXICAN PAVONIA (MALVACEAE)—PAVONIA **anisaster** (Standley) Fryxell, comb. nov.

Based on: *Hibiscus anisaster* Standley, Publ. Field Mus. Nat. Hist., Bot. Ser. 4: 230. 1929. Type: Nayarit, between Tepic and Santiago, alt. 1000 m, 15 Sep 1926, *Mexia 634* (GH! UC! US!).

Standley placed this plant in the wrong genus because the material he studied and described did not have mature fruits, nor did he evidently count the stigmas (five in *Hibiscus*, ten in *Pavonia*). The opportunity to examine specimens with mature fruits, collected more recently from the same area (*Feddema 820*, *McVaugh 13375*, *McVaugh 18836*), which are clearly conspecific with the Mexia collection that is the basis for Standley's name, makes it clear that the species is correctly placed in *Pavonia*.

Pavonia anisaster is allied to *P. firmiflora* Schery, *P. racemifera* Hooker & Arnott, *P. palmeri* (E. G. Baker) Schery, *P. ortegiana* (Standley) Standley, *P. spicata* Cavanilles, and *P. rhizophorae* Killip. It differs from these species most noticeably in having a dark red corolla.

PAVONIA **oxyphylla** (Moçiño & Sessé ex DeCandolle) Fryxell, comb. nov.

Based on: *Hibiscus oxyphyllus* Moçiño & Sessé ex DeCandolle, Prodr. 1: 455. 1824. Type: in Mexici montibus Xochipici (fl. mex. ic. ined.—IDC microfiche, 86).

Synonyms:

Pavonia glandulosa Presl, Rel. Haenk. 2: 129. 1835. Type: Mexico, *Haenke s.n.* (PR—4 sheets!).

Pavonia melanommata var. *pringleana* R. E. Fries, K. Svensk. Vet. Akad. Handl. 42: 43. 1907. Type: Morelos, near Yautepec, *Pringle 8718* (MEXU! MO! UC! US!).

Pavonia glandulosa Presl has been regarded previously as a doubtful name (Contr. U. S. Natl. Herb. 23: 773. 1923; Leafl. W. Bot. 7: 122. 1954) and *Hibiscus oxyphyllus* has generally been retained in *Hibiscus*, usually as a synonym of *H. brasiliensis* L. (Annuaire Cons. Jard. Bot., Genève 4: 87. 1900; Contr. U. S. Natl. Herb. 23: 781. 1923; Leafl. W. Bot. 7: 283. 1955). An examination of type material of Presl's name and of the description and illustration upon which DeCandolle's name is based requires the presentation of the above new combination in specific rank and the following new combination in varietal rank.

PAVONIA **oxyphylla** (Moç. & Sess. ex DC.) Fryx. var. **melanommata** (Robinson & Seaton) Fryxell, stat. et comb. nov.

Based on: *Pavonia melanommata* Robinson & Seaton, Proc. Amer. Acad. Arts 28: 104. 1893. Type: Michoacán: Monte León, *Pringle 4343* (ARIZ! GH! MO! NY! UC! US—2 sheets!).

Discussion of the distributional and morphological differences between these two varieties and further specimen citations may be found in Brittonia 25: 83-85. 1973.—*Paul A. Fryxell, Agronomy Field Laboratory, Texas A&M University, College Station, Texas 77843.*

SEED GERMINATION AND SEEDLINGS OF KRAMERIA LANCEOLATA (KRAMERIACEAE)—*Krameria lanceolata* Torr. (=*K. spathulata* Small), sandspur, a suffrutescent low-growing perennial, has thin, wiry rhizomes and large, fleshy storage roots. The small, lanceolate, canescent leaves are deciduous.

Parasitism was first reported in the genus *Krameria* in 1910 (Cannon 1910), but the parasitic behavior of *K. lanceolata* was not recorded until recently (Musselman 1976). Like many species of Scrophulariaceae, Olacaceae, and Santalaceae, *Krameria lanceolata* is a hemiparasite, forming haustoria on roots of neighboring plants. It likewise has a broad host range, attaching to trees, shrubs, grasses, and other plants.

Krameria lanceolata occurs from Kansas south to Arizona, Texas, Chihuahua, and Coahuila, Mexico with disjunct populations in Florida and Georgia. In Georgia it occurs on sandy ridges along coastal rivers, and in Florida it is found mostly on deep sands in several northern and central countries. The largest populations we found were near Tampa, Florida.

Very little is known about the life history of these plants. In a review of previous work on this genus Kuijt (1969) states: "We know virtually nothing about the process of germination" and, further, "the entire process of germination . . . is unexplained." Our note records, apparently for the first time, information on germination and seedling development. Observations were made during a cooperative study between Old Dominion University and the Southern Forest Experiment Station of the U. S. Forest Service to survey all root parasites in the Southeast relative to their potential as pathogens of commercial tree species.

METHODS AND MATERIALS

Fruits were collected in June 1976 at the ecology study area of the University of South Florida in Tampa and immediately sent to the Forest Service laboratory, Pineville, Louisiana, where they were planted with approximately 20 commercial tree species. Voucher specimens are deposited in the herbarium of Old Dominion University (ODU) and the herbarium of the University of South Florida (USF). Twenty surplus fruits were soaked in water for 48 hours and the seeds were excised. Eleven seeds enlarged due to imbibition of water; nine remained the same size. The 11 enlarged seeds were placed on moist fiber in a germination room maintained at 24° C with 16 hours of light and 8 hours of dark. Only five seeds germinated; they were planted in pots with *Pinus taeda* seedings.

OBSERVATIONS AND DISCUSSION

The ovary of *K. lanceolata* contains two ovules, one of which always aborts. We found nothing resembling the situation in *K. grayi* reported by Kuijt (1969) where apparently mature fruits did not contain well-developed seeds. We estimate that as many as 70% of the fruits had fully developed seeds in them. The morphology of the seed is similar to that illustrated by Kuijt as a fruit [sic] of *K. parviflora* var. *glandulosa* (Kuijt 1969: 156). The fleshy cotyledons contain an unusually large amount of starch. A thin testa covers the seed. None of the seeds planted in pots with potential hosts germinated. We attribute this to the low temperature (24° C) at which pots were maintained and to the soil used in the pots. Therefore, the information we present on germination is based on seeds removed from the fruits. However, this form of germination appears to be identical to that observed in the few fruits that dehisced and germinated in petri dishes. Germination in petri dishes was epigeal, in contrast to the suggestion of Kuijt (1969).

After 3 days on moist fiber, the radicle began to elongate and exhibited positive geotropism. At this stage, the seedling had a well-developed root cap but no root hairs. Secondary growth began about a week after germination with a resultant sloughing of cortical cells on the oldest part of the primary root. Secondary roots developed within 2 weeks of germination. While only a few seedlings were available for study, no haustorial attachments were noted in those seedlings that had been with their host plant for 10 days. Thus, it appears that the early stage of seedling development resembles many other root parasites in being autotrophic.

Germination and seedling development of *K. lanceolata* is similar to those of other root parasites such as those Scrophulariaceae, Santalaceae, and Olacaceae examined in our studies (Musselman and Mann, unpublished). Except for *Striga asiatica* (Scrophulariaceae), a germination stimulant is not necessary for germination or seedling development in these families. The one striking feature of the seedling of *K. lanceolata* is the apparent absence of root hairs.—*Lytton J. Musselman, Department of Biological Sciences, Old Dominion University, Norfolk VA 23508 and William F. Mann, Jr., U.S.D.A. Forest Service, Southern Forest Experiment Station, Pineville, LA 71360.*

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NOTICE

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SIDUS SIDARUM—II[1]

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NOTE 1. A NEW SPECIES OF SIDA FROM MEXICO.

Both Standley (1923) and Kearney (1954) state that *Sida xanti* A. Gray occurs both in Baja California and in Sonora in the vicinity of Guaymas. The plant is localized and seldom collected in the latter area. Careful examination of specimens collected near Guaymas shows that they differ in several characters from the plants that grow in the Baja California peninsula and deserve recognition as a distinct species, which is described below.

1. SIDA **hyalina** Fryxell, spec. nov.

Suffrutex erectus. Caules teres, dense atque minute stellato-puberuli. Folia ovata vel lanceolata, e basi grosse dentata, ad basim truncata, apice acuta, palmatim 3–5 nervata, utrinque molli-puberula, usque ad 3.5 cm longa 1.5 cm lata, sursum gradatim minora et angustiora. Petioli usque ad 12 mm longi, quam lamina 1/4—1/2 longiori, molli-puberuli, vix canaliculati. Stipulae 4–7 mm longae, filiformes, puberulae, caducae. Pedunculi axillari, solitarii, 1.0–2.5 cm longi, supra medium articulati, molli-puberuli, floribus saepe apicem versus aggregatis; pedicelli 2–5 mm longi. Calyces 8–10 mm longi, obscure 10-costati, molli-puberuli, semi-divisi in 5 lobis triangularibus, ad basim late rotundati ubi fructiferi. Petala alba (luteola ubi marcida), 15–19 mm longa, obovata, obtusa, ad basim cuneata sine ungues manifestis, 10–15 mm lata, manifeste nervata, glabra praeter ad basim in margine interdum ciliata. Columna staminalis pallida, ubique stellato-pubescens, 3–5 mm longa, apice staminifera; filamenta ca. 1.5 mm longa, pallida, in 5 turmis disposita ut videtur; antherae numerosae (ca. 100), pallidae, ca. 0.7 mm longae. Styli ca. 9, per 3–4 mm columnam staminalem excedentes, pallidi; stigmata capitata, diametra stylorum vix excedentia, fuscata. Fructus schizocarpium ca. 9 mericarpiorum; mericarpia 4 mm alta, partibus inferiore manifeste reticulatis in parietibus lateralibus et dorsalibus, parietibus lateralibus cetera hyalinis vel translucentibus, partibus superiore elongata, retrorsum uncinata, ad apicem spina brevi (0.1 mm), parietibus lateralibus laevibus et apicem versus hyalinis; semen solitarium in basi mericarpiorum.

TYPE: Sinaloa: Cerros de Navachiste about Bahia Topolobampo; rocky volcanic slopes with coastal Thorn Forest, 26—30 Sep 1954, *H. S. Gentry 14301* (holotype: LL; isotypes: DES, US); road from Los Mochis to Topolobampo, talus slopes and rocky cliffs above salt flats, just north of Topolobampo; diffuse subshrub to 0.8 m tall; at 10:15 a.m. flowers not yet open, but corolla from previous day apparently yellow, 25 Oct 1973, *D. M. Bates & J. L. Vivaldi 3350* (paratypes: BH, pf); near Topolobampo, 15—25 Sept. 1897, *Palmer 199* (paratype: US).

[1] The first of this series was published in Sida 6: 1–6. 1975.

Sida hyalina is named to emphasize the distinctiveness of the hyaline nature of the mericarp wall, especially in the elongated apical portion.

Distinguishing features of the new species and *S. xanti* principally concern characters of the mericarps, which are glabrous to sparsely pubescent in *S. xanti* and retrorsely barbed in *S. hyalina*; the mericarps differ morphologically as depicted in Fig. 1. In addition, *S. xanti* tends to have longer peduncles, coarser pubescence, often has viscid pedicels, and usually has yellow-orange petals fading rose, whereas those of *S. hyalina* are white fading yellow. Mericarps of these two species and of *S. salviifolia* Presl are illustrated in Fig. 1. The latter species, which occurs from Sinaloa in western Mexico south to Colombia, is included in the discussion because it is evidently part of the same species-alliance and is in close geographical proximity to *S. hyalina*. A comparison of their mericarps shows a strong similarity in the retrorsely barbed spines and in the darkened marginal ribs of the apical part of the mericarp, which ribs by extension become the spines. Various other species are also a part of this alliance (including, but not confined to, the North American species *S. elliottii* Torrey & Gray, *S. tragiifolia* A. Gray, and *S. lindheimeri* Engelmann & Gray and the South American species *S. angustissima* St.-Hilaire, *S. cerradoensis* Krapovickas, *S. regnellii* R. E. Fries, *S. variegata* (Grisebach) Krapovickas, and *S. chalchaquensis* Rodrigo). *S. chalchaquensis* of northwestern Argentina deserves direct comparison with *S. hyalina* because its mericarps also have

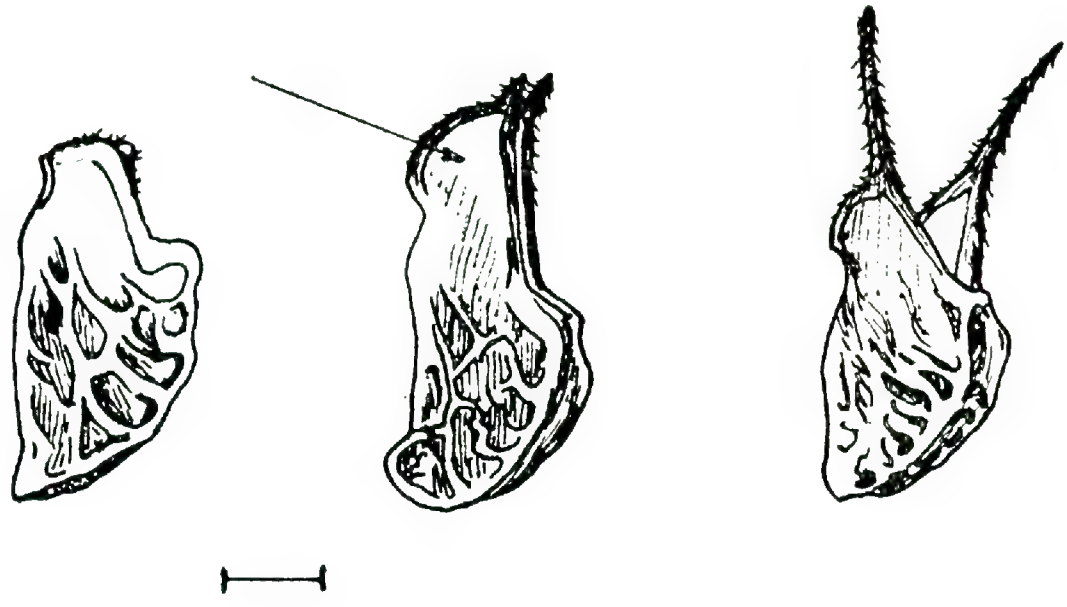

Figure 1. Individual mericarps, from left to right, of *Sida xanti*, *S. hyalina*, and *S. salviifolia* (vouchers: *Moran 7025*, *Gentry 14301*, and *Fryxell 1155a*, respectively). The arrow notes the hyaline area of the upper mericarp wall of *S. hyalina*. Scale = 1 mm.

a distinctive hyaline area at the apical end, although the two species are otherwise clearly distinct.

Characters common to members of this species alliance include:
(a) leaf form—a truncate or rounded base, remote dentation extending to the very base of the blade, and a more or less elliptical shape, varying from narrowly linear (*S. angustissima*) to broadly ovate-elliptic in several species;
(b) calyx—similarity of the disposition of the nerves and of pigmentation;
(c) filaments—organized more or less into five groups or phalanges as they emerge from the apex of the staminal column;
(d) corolla—a tendency to rose pigmentation;
(e) mericarps—usually 8—12 in number, prominently reticulate basally, the apical (dehiscent) portion relatively well-developed, broad, and with or without spines, the spines when present developed as extensions of marginal costae and retrorsely barbed.

The mericarps of this group of species are highly diverse, as Fig 1 shows, but they seem to be united by certain common morphological features, as I have indicated. Chromosome numbers are $n=7$ for *S. angustissima*, *S. regnellii*, and *S. variegata* and $n=14$ for *S. lindheimeri* (Krapovickas, 1957, 1969). The chromosome number is not known for *S. hyalina*.

NOTE 2—THE TYPE OF SIDA PROCUMBENS SWARTZ

Kearney (1954, 1958) accepts as *S. procumbens* Swartz a species commonly found from the southern United States to northern South America, including Mexico, Central America, and the West Indies. He lists the following synonyms for *S. procumbens: S. diffusa* H.B.K., *S. filicaulis* Torrey & Gray, *S. filiformis* Moricand (non Jacquin), *S. ovata* Cavanilles, *S. pilosa* Cavanilles, *S. supina* L'Heritier, and perhaps *S. caespitosa* Helwig. Kearney earlier (Kearney & Peebles, 1942) expressed doubt that *S. diffusa* and *S. procumbens* are distinct, but later, as stated above, concluded that they represent the same species, for which he adopted the older name.

Although most recent floras follow Kearney's usage, a few do not and adopt alternative names for this species—*S. diffusa* H.B.K. (Camargo, 1970) or *S. filicaulis* Torrey & Gray (Gould, 1969; Correll & Johnston, 1970; Jones, 1975). Shinners (1953) adopts the name *S. filiformis* Moricand, giving *S. filicaulis* as a synonym, ignoring *S. procumbens* Swartz. Swartz's name is the oldest of those given and therefore has priority over the others. To adopt an alternative name, as for example Correll & Johnston do, citing "*S. procumbens* of authors" as a synonym, implies either that Swartz's name is illegitimate or misinterpreted or that it represents a different species. I can find no serious contention in the literature nor does my field experience with the plant suggest that more than one species is involved. The validity of Swartz's name is not in doubt. However, it was necessary to establish the identity of the plant described by Swartz. Therefore, the type of *Sida procumbens* Swartz was examined through the cooperation and courtesy of the Director of the Stockholm herbarium, where

Figure 2. Type of *Sida procumbens* Swartz.

Swartz's types are preserved.

The type material of *Sida procumbens* Swartz is a mixed gathering. There are five separate branches affixed to the sheet (Fig. 2), the collection coming from Hispaniola. Three of these branches represent the species in question and, in the interest of nomenclatural stability, are chosen as lectotype material of *S. procumbens*. The other two branches represent *Sida spinosa* Linnaeus and are excluded from the typification of *S. procumbens*. Moreover, Swartz's description conforms to the chosen specimens and not to the discordant specimens of *S. spinosa* in two particulars: "foliis . . . villosis" and "caulibus procumbentibus hirsutis." On the basis of this lectotypification, I conclude that the correct name for this species is *Sida procumbens* Swartz.

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SECTIONAL AND SUBGENERIC NAMES IN *GENTIANA* (GENTIANACEAE)[1]

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The genus *Gentiana L.*, as traditionally circumscribed, constituted a large and heterogeneous group of species. The removal of *Crawfurdia* Wall., *Gentianella* Moench, *Megacodon* (Hemsl.) H. Sm., and *Tripterospermum* Blume—with *Gentianella* further divided by some authors into *Gentianella* s. str., *Comastoma* (Wettst.) Toyokuni, *Gentianopsis* Ma, and *Pterygocalyx* Maxim.—is now widely accepted, this restriction of *Gentiana* having been adopted in such standard references as *Flora Europaea* (Tutin 1972) and *Hortus Third* (Staff . . . 1976), and in treatments of Gentianaceae in several national and regional floras. The species remaining in *Gentiana* are generally recognized as constituting a natural group, sharing the morphological features listed in Pringle (1977), with these species being more closely related to each other than to the segregated groups.

A much narrower circumscription of *Gentiana* has been advocated by Holub (1973) and Löve & Löve (1975), who restricted the genus to the five species usually treated as its nominate section. A few authors, e.g., Toyokuni (1965), have taken intermediate positions. These further restrictions of *Gentiana*, however, have much less often been accepted. It remains appropriate, therefore, to discuss nomenclature of *Gentiana* as this genus is circumscribed in *Flora Europaea*.

Most 20th century authors on *Gentiana* have applied the rank of section to the major subdivisions of the genus. There has been close agreement on the number of sections recognized and on the assignment of species to sections. Consequently, it is possible to regard some sectional names as "operational," in that they are the correct names for the sections considered taxonomically acceptable in recent monographs. These sectional names appear in capitals in this paper. Other names published at the rank of section appear in italics, following the discussions of the accepted names with which, respectively, they are considered synonymous. The sequence of accepted names follows *Flora Europaea*. Names of sections not represented in this flora follow the names of the European sections to which they appear to be most closely related.

The scope of this paper is strictly nomenclatural. Problems of classification, such as transfers of species from one section to another, or the establishment of additional sections for anomalous species, are not dealt with

[1] Contribution No. 19 from the Royal Botanical Gardens, Hamilton, Ontario, Canada.

SIDA 7(3): 232–247. 1978.

here. Also excluded is any formal discussion of subdivisions of sections. Several authors have recognized such taxa, but none of their treatments has been widely followed, some being too locally oriented for general application, or having been established without adequate data on basic chromosome numbers. An extensive search of literature on these taxa has disclosed none having a name that would affect the legitimacy of the sectional names accepted here.

IMPORTANT SOURCES OF SECTIONAL NAMES

Reneaulme's (1611) *Specimen historiae plantarum* was the source of several epithets used by later authors as sectional names. Unitary names in this work were cited in synonymy at the species level in Linnaeus' (1753) *Species plantarum*. Sectional names derived from these unitary names may, in most cases, be typified by the species to which, according to Linnaeus, the unitary names were applied by Reneaulme.

The status of unitary names published in Necker's (1790) *Elementa botanica* is discussed in Article 20 of the *International code of botanical nomenclature* (ICBN), 1972 ed. Although incorrectly attributed to Necker, sectional names derived from names in this work have sometimes been validly published by later authors.

The four names published for subdivisions of *Gentiana* in Froelich's (1796) *De Gentiana libellus sistens* have sometimes been rejected as having been published sine ord., but Brizicky (1969) has pointed out that they were validly published as sectional names, noting that the subdivisions were referred to as sections in the introduction.

The sections into which *Gentiana* was divided by Froelich (1796) were accepted, with minor modifications, by Lamarck & de Candolle (1805) in their *Flore Française*, one of the earliest works in which the status of sections was indicated in a modern format. The four sectional names were attributed to Froelich, although they were altered from plural adjectives to nouns.

Link has often been cited as the author of sectional names in *Gentiana*. In Link's (1821-1822) *Enumeratio*, names of generic subdivisions were published sine ord., and must be rejected (Brizicky 1969). Sectional names were validly published in Link's (1827-1833) *Hortus Regius*, but *Gentiana* was not subdivided in this work. Link's (1829-1833) *Handbuch* does contain validly published sectional names in *Gentiana*, but none is the earliest available for any section included in the genus as circumscribed here.

In Dumortier's (1827) *Florula Belgica*, *Gentiana* was divided into five sections, three of them within the present generic circumscription. Brizicky (1969) and Stafleu & Cowan (1976) have accepted the generic subdivisions preceded by the symbol § in this work as validly published, formal sections. Suggestions that the *Florula Belgica* might have been published later than 1827 have been rejected as unsubstantiated by Stafleu & Cowan (1976); 1827 must therefore be accepted as its date of publication (Article 30, ICBN).

In Gaudin's (1828-1833) *Flora Helvetica*, *Gentiana* was divided into ten

subdivisions, six of them still referable to the genus. In this seven-volume work, the treatment of each genus begins with a key in which species are grouped according to morphological features. Beginning with Volume 2, groups of species in large genera, which were described in the keys, were given names printed in small capitals. In Volume 5, such a subdivision of *Hieracium* is referred to as a section (Latin *sectio*). A recent amendment to Article 35 of ICBN (Stafleu & Voss 1975, Voss 1976) clearly indicates that all names for subdivisions of genera designated by the same format in this flora should be accepted as having been published at the rank of section.

Bunge's (1829) monograph on *Gentiana*, Grisebach's (1837) treatment of the Gentianaceae in Hooker's *Flora Boreali-Americanae*, and Grisebach's (1838, 1845) two major treatises on the Gentianaceae of the world brought the subdivision of *Gentiana* close to modern practice. In all these works, the sections are described and their rank is clearly indicated. Some epithets used as sectional names by Grisebach had previously been used as generic names by Adanson (1763). These names are interpreted here as new names rather than as new combinations, since Adanson's use of the epithets was not cited by Grisebach; the epithets could have been taken directly from pre-Linnaean sources; and Grisebach's (1845) use of the epithet *Dasystephana* differed greatly from Adanson's.

Groups of species given Latin names in Huxley's (1888) phylogenetic study of the "natural order Gentianeae" (i.e., the family Gentianaceae) have sometimes been interpreted as subdivisions of *Gentiana* because they cut across the traditional circumscription of the genus, some species being assigned to each of his two "series." Actually, however, these groups are suprageneric. Huxley's Perimelitae included not only a portion of the traditional *Gentiana* but also *Halenia* and *Swertia*. His even more inclusive Mesomelitae comprised not only the remainder of *Gentiana* but also many other genera, e.g., *Sabatia*, *Voyria*, and even *Menyanthes*. No suggestion was made that all of these genera should be included in *Gentiana*; instead Huxley recommended that *Gentiana* s. lat. be divided. The two "series" were further divided, but the subdivisions were assigned no rank and in some cases comprised more than one accepted genus.

The last of the major contributors to division of *Gentiana* into sections was Kusnezow. His monograph of "subgenus *Eugentiana*" (1894) and his treatment of *Gentiana* in *Die natürlichen Pflanzenfamilien* (1895) have served as the basis for most subsequent treatments of *Gentiana* at the sectional level.

NAMES OF SECTIONS

Sect. GENTIANA

The first restriction of *Gentiana* pertinent to its typification was made by Adanson (1763), who included only *G. lutea* L. in this genus and transferred other Linnaean species of *Gentiana* to new genera. *Gentiana lutea* has been

accepted as the type species of the generic name in all recent publications on the genus. Any section including *G. lutea* must therefore be called sect. *Gentiana*; any other name is illegitimate.

[Sect.] *Asterias* Gaudin, Fl. Helv. 2:269. 1828.

Sect. *Asterias*, as established by Gaudin, included only *G. lutea* and *G. hybrida* Schleich. ex DC., the latter interpreted as a probable hybrid between *G. lutea* and *G. purpurea* L. Previously, the epithet *Asterias* had been used by Reneaulme (1611) as a unitary name for *G. lutea* and by Borkhausen (1796) as the name of a genus consisting only of *G. lutea*.

[Sect.] *Coelanthae* Froel., De Gentiana libellus p. 15. 1796. Type species (Article 7, ICBN): *Gentiana lutea* L.

The sectional epithet *Coelanthae* is derived from *Coilantha*, a unitary name used by Reneaulme (1611) for *G. purpurea* L. However, since Froelich (1796) did not directly equate his sect. *Coelanthae* with *Coilantha* Reneaulme, his choice of an epithet hardly constitutes a definite indication of a type. Because sect. *Coelanthae*, as circumscribed by Froelich, included *G. lutea*, its name is superfluous, and *G. lutea* must be accepted as its type.

[Sect.] *Coelanthae* Bunge, Nouv. Mém. Soc. Imp. Naturalistes Moscou 1:206. 1829, non Froel., 1796.

Gentiana purpurea and three closely related species are usually placed in the same section as *G. lutea*, which they resemble in general habit and with which they are interfertile, e.g., by Kusnezow (1894, 1895) and Tutin (1972). However, because of the unique deeply lobed corolla, without appendages, of *G. lutea*, some authors, including Gaudin (1828), Bunge (1829), and Grisebach (1838, 1845), have placed this species in a monotypic section.

Bunge (1829) retained *G. purpurea* and two related species in sect. *Coelanthae* (attributed to Froelich) but transferred *G. lutea* to sect. *Asterias*. Since sect. *Coelanthae* Froel. must be typified by *G. lutea*, its application to a section from which *G. lutea* is excluded is illegitimate. Gaudin (1828) treated this group as sect. *Gentiana*, and later authors, e.g., Grisebach (1838, 1845), generally used the sectional name *Coelanthe* [sic]. It appears, therefore, that no legitimate name has been published for a section comprising *G. purpurea* and closely related species but not including *G. lutea*.

[Sect.] *Gentianotypus* Dumort., Florula Belg. p. 51. 1827.

This is a superfluous name for a section in which only *G. lutea* was listed.

[Sect.] PNEUMONANTHE Gardin, Fl. Helv. 2:269. 1828. Type species (Article 22, ICBN): *Gentiana pneumonanthe* L.

Greene (1904) has reviewed the early history of the epithet *Pneumonanthe*. Tutin (1972), Pringle (1977), and other recent authors have recognized Gaudin (1828) as the first to have validly published the combination *Gentiana* sect. *Pneumonanthe*, its earlier use by Link (1821) having been sine ord.

Sect. *Cyane* Griseb. in Hook., Fl. Bor.-Am. 2:54. "1845" [1837]. Type species (Article 7, ICBN): *Gentiana pneumonanthe* L.

The epithet *Cyane* is derived from the unitary name *Cyana*, applied by Reneaulme (1611) to *Gentiana pneumonanthe*. Although Grisebach (1837) first published the combination *Gentiana* sect. *Cyane* in a work in which only North American species were described, his frequent mention of *G. pneumonanthe* and his attribution of the epithet *Cyane* to Reneaulme clearly indicate that this species was included in his original concept of this section. Therefore, *G. pneumonanthe* must be accepted as the type species of this sectional name.

Sect. KUDOA (Masamune) Satake & Toyokuni ex Toyokuni, J. Jap. Bot. 35:202. 1960. Based on *Kudoa* Masamune, J. Trop. Agric. 2:29. 1930 (pro gen.). Type species: *Gentiana yakushimensis* Makino, as *Kudoa yakushimensis* (Makino) Masamune.

Section *Kudoa*, which was accepted by Toyokuni (1963) but not by Smith (1967), consists of Asiatic species that in most earlier works were placed in sect. *Frigidae*. At least the type species, however, was recently placed in sect. *Pneumonanthe* by Smith (1967). The reduction of *Kudoa* from generic to sectional status met current requirements of the ICBN.

Sect. STENOGYNE Franch., Bull. Soc. Bot. France 31:375. 1884. Type species: *Gentiana primuliflora* Franch.

This sectional name was published in accord with current requirements. The only species placed in sect. *Stenogyne* by Franchet (1884) was *G. primuliflora*. The sectional circumscription was considerably expanded by Kusnezow (1894), but *G. primuliflora* has consistently been included in this section.

Sect. FRIGIDAE Kusn., Trudy Imp. S.-Peterburgsk. Bot. Sada 13:61. 1893, "*Frigida*." Type species (Article 22, ICBN): *Gentiana frigida* Haenke.

Article 21 of ICBN, on the names of subdivisions of genera, requires that the epithets be "either of the same form as a generic name, or a plural adjective." Since *Frigida* is a singular adjective, its orthography must be changed to *Frigidae* (Article 32, Note 1, ICBN). Otherwise, the publication of this sectional name met current requirements.

Sect. *Isomeria* Kusn., Trudy S.-Peterburgsk. Obshch. Estestvoisp., Otd. Bot. 24(2):198. 1894. Lectotype species (hoc loc.): *Gentiana depressa* D. Don.

Section *Isomeria*, when established by Kusnezow (1894), comprised five species: *G. cachemirica* Decne., *G. delavayi* Franch., *G. depressa* D. Don, *G. emodi* Marq. (as *G. amoena* C.B. Clarke, non Wedd.), and *G. loderi* Hook. fil. (now generally included in *G. cachemirica*). Smith (1961) considered this grouping to be unnatural, and assigned *G. cachemirica* (including *G. loderi*) to sect. *Pneumonanthe* and the remaining species to sect. *Frigidae*.

Although the sectional name *Isomeria* is not required in currently accepted treatments of *Gentiana*, the name is not illegitimate. It seems appropriate, therefore, to designate a lectotype in case any of the species named above should later be removed from the section to which it was assigned by Smith (1961). Of these species, *G. depressa* appears to fit Kusnezow's (1894, 1895) generalized descriptions of sect. *Isomeria* most closely. It is, moreover, a well-known species, which also typifies the name of the series (sect. *Frigidae* subsect. *Sympodiae* series *Depressae* H. Sm.) to which it and *G. emodi* were assigned by Smith (1961).

[Sect.] CRUCIATA Gaudin, Fl. Helv. 2:269. 1828. Type species (Article 22, ICBN): *Gentiana cruciata* L.

Although the epithet *Cruciata* may appear to be a singular adjective, it is actually "of the same form as a generic name." *Cruciata* was a pre-Linnaean generic or unitary name variously applied to species with decussate leaves or with leaves in whorls of four. Since 1753, it has in fact been used as a generic name in both the Gentianaceae and the Rubiaceae. Its association with *Gentiana cruciata* can be traced back to Bauhin & Cherler's (1651) designation of this species as "*Gentiana minor, seu vulgi Cruciata,*" and to other pre-Linnaean applications of "*Cruciata,*" as a noun, to this species (listed by Bauhin & Cherler 1651).

[Sect.] *Erythaliae* Bunge, Nouv. Mém. Soc. Imp. Naturalistes Moscou 1:207. 1829. Type species (Article 7, ICBN): *Gentiana cruciata* L.

As circumscribed by Bunge (1829), sect. *Erythaliae* included *G. cruciata*. This sectional name, therefore, is superfluous.

Sect. *Tretorrhiza* Griseb. in Hook., Fl. Bor.-Am. 2:60. "1845" [1837]. Lectotype species (hoc loc.): *Gentiana cruciata* L.

The epithet *Tretorrhiza* is derived from a unitary name applied by Reneaulme (1611) to *G. cruciata*. Because sect. *Tretorrhiza* was first described in a work on North American plants, *G. cruciata* was not included in this publication. *Gentiana douglasiana* Bong. was the only North American species assigned to this section. Grisebach's (1837) attribution of the sectional name to Reneaulme, however, constitutes a direct link between *G. cruciata* and the original description of this section. Fifteen months later, when Grisebach (1838) published on Gentianaceae of the world, sect. *Tretorrhiza* appeared as a natural group of species, of which *G. cruciata* was representative, except that *G. douglasiana* then constituted a discordant element. *Gentiana douglasiana* does not appear to have been of great importance in the preparation of the original description of sect. *Tretorrhiza*, since the section was said to consist of perennial herbs, although *G. douglasiana* is annual. Therefore, *G. cruciata* is interpreted as having been included in all circumscriptions of sect. *Tretorrhiza*, and, in accord with Article 7 of the ICBN, this species is regarded here as the type of the sectional name. This

sectional name is consequently considered to be illegitimate.

Sect. *Kurroo* C.B. Clarke, J. Linn. Soc., Bot. 14:433. 1875. Type species (Article 22, ICBN): *Gentiana kurroo* Royle.

Section *Kurroo*, as established by Clarke (1875), comprised *G. kurroo* and three other rosette-forming Himalayan species that Clarke correctly realized had been misplaced in sect. *Pneumonanthe* (by Grisebach 1845). Kusnezow (1894), however, noting the similarity of these species to *G. cruciata*, placed them in his sect. *Aptera* (= sect. *Cruciata*). As long as *G. kurroo* and *G. cruciata* are included in the same section, the sectional name *Kurroo* is not required.

Sect. *Aptera* Kusn., Trudy Imp. S.-Peterburgsk. Bot. Sada 13:62. 1893.

Since the paper in which sect. *Aptera* was first described (Kusnezow 1893) dealt only with new taxa, only *G. kaufmanniana* Regel & Schmalh. var. *affghanica* Kusn. and *G. biflora* Regel ex Kusn. were described under this sectional heading in this work. The following year, Kusnezow (1894) indicated the full scope of the section, which included *G. cruciata*. In this work, the sectional name *Aptera* was clearly superfluous. Even if *G. kaufmanniana* or *G. biflora* should be designated the lectotype, it is highly unlikely that the name *Gentiana* sect. *Aptera* would find any legitimate usage, since these species have consistently been regarded as being consectional with *G. cruciata*.

[Sect.] CHONDROPHYLLAE Bunge, Nouv. Mém. Soc. Imp. Naturalistes Moscou 1:207. 1829. Lectotype species (hoc loc.): *Gentiana aquatica* L.

Gentiana aquatica is here designated the lectotype of the name *Gentiana* sect. *Chondrophyllae* because it is a well-known, Linnaean species, which was illustrated and described in detail by Bunge (1829), and from which Bunge distinguished other species assigned to this section. Bunge's description of *G. aquatica* corresponds especially closely to his description of this section, and the cartilaginous leaf margins, from which the sectional epithet is derived, are shown in Bunge's illustration of this species only.

Sect. *Eurythalia* Griseb., Gött. Gel. Anz. 1840-815. 1840, non [sect.] *Erythaliae* Bunge, 1829. Lectotype species (hoc loc.): *Gentiana coronata* Royle.

Eyrythalia was used by Reneaulme (1611) as a unitary name for *Gentianella campestris* (L.) Börner. Borkhausen (1796) applied this epithet to a genus initially comprising this and three other species, two of them referable to *Gentianella* s. str. Don (1837) ascribed the generic name *Eurythalia* (an orthographic variant, both *y* and *u* being used as transliterations for the Greek letter *υ*) to Reneaulme and Borkhausen. The two species assigned to *Eurythalia* by Don, *Gentiana carinata* (D. Don) Griseb. and *G. coronata* Royle, along with *G. hugelii* Griseb., have corolla traits similar to those of some *Gentianella* species as well as those characteristic of *Gentiana*. It may be assumed, therefore, that Don was placing newly described species

in *Eyrythalia* Borkh., rather than establishing a new genus at variance with Borkhausen's concept of *Eyrythalia*.

Grisebach (1840) considered his *Gentiana* sect. *Eurythalia* to be based on *Eurythalia* sensu D. Don but broke the nomenclatural continuity by restricting the section to the three species named above. The species placed in *Eyrythalia* by Borkhausen, except the incongruous *G. septemfida* Pallas, were placed in sect. *Amarella* by Grisebach (1838, 1845). Therefore, *Gentiana* sect. *Eurythalia* Griseb. must be regarded as a new name rather than a new combination.

The three species placed in sect. *Eurythalia* by Grisebach were transferred to sect. *Chondrophyllae* by Clarke (1883) and have generally been included in sect. *Chondrophyllae* by later authors. Further studies, however, may indicate that this group should be restored to sectional status, in which case a new epithet will be required unless *Eurythalia* and *Erythaliae* are deemed to be sufficiently distinct.

[Sect.] CIMINALIS (Adans.) Dumort., Florula Belg. p. 51. 1827. Based on *Ciminalis* Adans., Fam. pl. p. 504. 1763 (pro gen.). Lectotype species (Holub 1973): *Gentiana acaulis* L., as *Ciminalis* [sp.].

Three species—*Gentiana acaulis* L., *G. pneumonanthe* L., and *G. verna* L.—were originally included in *Ciminalis* by Adanson (1763). Each of these is now placed in a different section of *Gentiana*. Holub (1973), in designating *G. acaulis* the lectotype, noted that the genus *Ciminalis* had in effect been restricted by later authors, citing Gleditsch's (1764) publication of the generic name *Pneumonanthe*, typified by *G. pneumonanthe*, and Moench's (1794) listing only *G. acaulis*, as *Ciminalis longifolia* Moench, under *Ciminalis*. Moench did not state that the other species placed in this genus by Adanson were excluded, but his description of the stigma of *Ciminalis* was not applicable to *G. pneumonanthe*.

Ciminalis was more definitely restricted by Rafinesque (1837), who equated *Ciminalis* with *Thylacitis* Reneaulme (1611), i.e., *G. acaulis*, and assigned to it "*C. grandiflora, angustif*[*olia*], *alpina* &c which were *Gent*[*iana*] *aphyla* [evidently a lapsus calami for '*acaulis*'] and 2 var. of Authors." Both *G. pneumonanthe* and *G. verna* were transferred to other genera. Since *G. acaulis* was retained in *Ciminalis*, and since Rafinesque said that his *Ciminalis* was that of Moench, who had attributed its authorship to Adanson, Rafinesque was restricting *Ciminalis* Adans. rather than reapplying the epithet. Placement of "*Ciminalis* Raf." in synonymy with *Voyria* Aubl. (Index Kewensis; Merrill 1949) is incorrect, "*Gent. aphyla*" having been interpreted as *Gentiana aphylla* L. (= *Voyria aphylla* (L.) Pers.) rather than as an error. *Gentiana grandiflora* Lam. (now included in *G. acaulis*), *G. angustifolia* Vill., and *G. alpina* Vill. all apply to closely related taxa in sect. *Ciminalis*; their specific epithets have never been associated with *Voyria*. Recently, Löve & Löve (1975) restricted *Ciminalis* to species having a base

chromosome number nine, including *G. acaulis* ($n = 18$), but excluding *G. pneumonanthe* ($n = 13$) and *G. verna* ($n = 14$).

Sect. *Megalanthe* Gaudin, Fl. Helv. 2:270. 1828.

This name has been adopted in some recent publications, but, since its original circumscription by Gaudin (1828) included *G. acaulis*, the type species of the earlier sectional name *Ciminalis* (Adans.) Dumort., the name is superfluous.

Sect. *Thylacites* Griseb. in DC., Prodr. 9:115. 1845.

The epithet *Thylacites* is derived from *Thylacitis* Reneaulme (1611), a unitary name for *G. acaulis*. Since Grisebach's (1845) original circumscription of sect. *Thylacites* included the type species of the earlier sectional name *Ciminalis* (Adans.) Dumort., this name is superfluous.

[Sect.] CALATHIANAE Froel., De Gentiana libellus p. 57. 1796. Lectotype species (hoc loc.): *Gentiana nivalis* L.

As noted by Bauhin & Cherler (1651), the word "*Calathiana*" appeared in pre-Linnaean names for several low-growing gentians. Particularly prominent in this work were the *Calathiana verna* of Dalechamps, evidently equivalent to *Gentiana verna* L., and Bauhin & Cherler's own *Gentianellis affinis, Calathiana verna Dalechampii, cum albis staminibus*, which was probably the closely related *G. nivalis*. These pre-Linnaean names were presumably important in relation to Froelich's (1796) use of *Calathianae* as a sectional epithet. As described by Froelich (1796), sect. *Calathianae* comprised mostly low-growing, alpine species, characterized by infundibuliform corollas, whereas species in sect. *Coelanthae* were said to have campanulate corollas. Sect. *Calathianae* sensu Froelich was equivalent to sect. *Calathianae* in its present circumscription plus sect. *Chondrophyllae* and sect. *Ciminalis*.

Section *Calathianae* Froel., with its epithet altered to *Calathia*, was accepted by Lamarck & de Candolle (1805). Notably, however, they transferred *G. acaulis*, the only species in their work that would now be placed in sect. *Ciminalis*, from sect. *Calathianae* to sect. *Coelanthae*. The residual sect. *Calathianae* sensu Lamarck & de Candolle was thus equivalent only to sect. *Calathianae* s. str. plus sect. *Chondrophyllae*.

Bunge (1829) further narrowed the circumscription of sect. *Calathianae*. *Gentiana nivalis* and closely related species were retained in this section; *G. aquatica* and its relatives were transferred to the new sect. *Chondrophyllae*.

Because *G. nivalis* was included by Froelich (1796) in his sect. *Calathianae* and fits his description of this section, and because it also figured prominently in Bunge's (1829) redefinition of sect. *Calathianae*, this species is here designated the lectotype of the name *Gentiana* sect. *Calathianae*. This lectotypification, moreover, is compatible with Holub's (1793) and

Löve & Löve's (1975) treatment of *G. nivalis* as the type of generic name *Calathiana* Delarbre, this being the only species placed in this genus by Delarbre (1800).

[Sect.] *Ericoila* Dumort., Florula Belg. p. 51. 1827. Type species (Article 7, ICBN): *Gentiana nivalis* L.

Gentiana sect. *Ericoila* Dumort. was based on *Ericoila* Borkh. (pro gen.), which is an illegitimate name because Borkhausen's (1796) circumscription of *Ericoila* included the type species of the earlier generic name *Tretorhiza* Adans. (Holub 1973). The sectional name must therefore be treated as a new name originated by Dumortier (Article 72, ICBN) rather than as a new combination, and *Gentiana cruciata* need not be regarded as its type, even though it must be accepted as the type of *Ericoila* Borkh. Dumortier's (1827) citation of "*Ericoila* Bork." does suffice as a reference to a published description. Section *Ericoila* sensu Dumortier was evidently equivalent to Borkhausen's genus *Ericoila*, since Dumortier did not supply any amended description, and his inclusion of two relatively dissimilar Belgian species, *G. cruciata* and *G. bavarica* L., in this section did not indicate any reduction in its scope. Thus *Gentiana* sect. *Ericoila* by implication included *G. nivalis*, which is highly similar to *G. bavarica* in floral morphology and which had also been transferred to *Ericoila* by Borkhausen (1796). This name, therefore, is regarded as illegitimate.

[Sect.] *Gentianella* Gaudin, Fl. Helv. 2:270. 1828, non Dumort., 1827.

Section *Gentianella* Gaudin (1828) comprised *G. nivalis* and *G. utriculosa* L. This sectional name is superfluous because the section included the type species of sect. *Calathianae* Froel., and also because it is a later homonym of sect. *Gentianella* Dumort.

[Sect.] *Hippion* (F.W. Schmidt) Gaudin, Fl. Helv. 2:270. 1828. Based on *Hippion* F.W. Schmidt, Fl. Boëm. Inchoata 2:18. 1793 (pro gen.). Lectotype species (hoc loc.): *Gentiana verna* L., as *Hippion aestivum* F.W. Schmidt.

Bauhin & Cherler (1651) reviewed the early use of "*Hippion*" in the names of *Gentiana* species. Their *Gentianella quae Hippion* was equated by Linnaeus (1753) with his *Gentiana verna*. The genus *Hippion* F.W. Schmidt (1793) included *G. verna* in its original circumscription. Gaudin's (1828) *Gentiana* sect. *Hippion* was obviously based on *Hippion* F.W. Schmidt, as indicated by his citation of this generic name and combinations made therein by Schmidt. Gaudin, however, restricted *Hippion* to three Swiss species, of which *G. verna* seems to have been most important in the preparation of the sectional description.

Subsequent authors have not followed Gaudin in placing *G. verna* and *G. nivalis* in different sections. The basic chromosome number seven prevails in both groups, although, as noted by Gaudin, the groups do differ in longevity and to some extent in habit.

Sect. *Cyclostigma* Griseb., Gen. Sp. Gentianearum p. 259. "1839" [1838].

This sectional name is illegitimate because the section thus named included *G. nivalis*, the type species of *Gentiana* sect. *Calathianae* Froel., as well as the type species of other, earlier sectional names.

Sect. OTHOPHORA Kusn., Trudy S.-Peterburgsk. Obshch. Estestvoisp., Otd. Bot. 24(2):102. 1894. Type species: *Gentiana otophora* Franch.

Originally, only one species, *G. otophora* Franch., was placed in sect. *Othophora* by Kusnezow (1894). Although the sectional epithet differs in spelling from the specific epithet from which it was derived, Kusnezow's (1894, 1895) consistent use of this spelling indicates that it was intentional, rather than a typographical error. It may be suspected that Kusnezow employed "*Othophora*" as a singular adjective, but it coincidentally has the form of a generic name, comparable to *Otophora* Blume (Sapindaceae) and several other generic names ending in "*-phora*."

NAMES OF SUBGENERA

The rank of subgenus in *Gentiana* has generally been used to designate groups that are excluded from the genus in its present circumscription. Since this rank has not been used in any recent works in which this restriction of the genus has been adopted, only an informal discussion of subgeneric names is presented here.

The first subgenera comprising species still referable to *Gentiana* were established by Rafinesque. In his *Medical flora* (1828), *Gentiana* was divided into three subgenera: *Rotularia*, typified by *G. lutea*, its name therefore being superfluous; *Pneumonanthe*, its epithet indicating *G. pneumonanthe* as the type species; and *Eublephis*, comprising species now excluded from *Gentiana*.

Reichenbach also published the name *Gentiana* subgenus *Pneumonanthe* in 1828. Since Reichenbach's *Conspectus* was published in December of that year (Stafleu 1967), it seems probable that it was antedated by Volume 1 of Rafinesque's *Medical flora*, although the month in which this volume was published has not been determined. Reichenbach (1828) also published the name *Gentiana* sect. *Hippion*, based on *Hippion* F.W. Schmidt (pro gen.) and therefore typified by *G. verna*.

In Rafinesque's (1837) *Flora Telluriana*, *Gentiana* s. lat. was divided into several genera, some of which were further divided into subgenera. Four of these subgenera fall within the present concept of *Gentiana*. Rafinesque established three subgenera within the residual genus *Gentiana*. Subgenus *Picriza* was typified by *G. lutea*, its name therefore being superfluous (the earlier name *Rotularia* was not mentioned). For subgenus *Pleuroglossa*, *G. punctata* and *G. purpurea* were cited as cotypes. Merrill (1949) listed *G. punctata* as the type, but his arbitrary listing of the first of two or more cotypes as the type does not constitute binding lectotypification under Article 8 of the ICBN. Rafinesque's description of subgenus *Pleuroglossa* was

clearly based almost entirely on *G. purpurea*, containing elements inapplicable to *G. punctata*, and therefore *G. purpurea* is designated the lectotype here. Subgenus *Tulbela* was typified by *G. septemfida* Pallas (as *G. rossica* Raf.), which was incongruously retained in *Gentiana* even though closely related species were removed to segregate genera.

The fourth pertinent subgeneric epithet in the *Flora Telluriana* is *Cutlera*. This epithet had previously been used by Rafinesque as a generic name, although never validly published as such, and in some works appeared as "*Cuttera*," evidently a typographical error. The first species transferred to this proposed genus were *Gentiana saponaria* L. and *G. villosa* L., with *G. catesbaei* Walt. being added later (Merrill 1949). In the *Flora Telluriana*, however, *Cutlera* appeared as a subgenus in the new genus *Xolemia* Raf. It is not clear which of the species assigned to *Xolemia* were considered to be the "true Xolemias" and which constituted subgenus *Cutlera*. *Gentiana catesbaei*, however, seems to correspond most closely to Rafinesque's diagnosis of subgenus *Cutlera*, in having relatively open corollas.

Rafinesque (1837) also published the name *Amarella* subgenus *Hippion* in *Flora Telluriana*. The generic name *Hippion* F.W. Schmidt was cited in synonymy, but *Gentiana viscosa* Ait. (= *Ixanthus viscosus* (Ait.) Griseb.) was expressly stated to be the type of this subgeneric name. This species had never been included in *Hippion* by Schmidt. Moreover, *G. verna*, accepted here as the type species of *Hippion* F.W. Schmidt, was placed in *Ricoila* by Rafinesque. *Amarella* subgenus *Hippion* must therefore be regarded as a new name rather than a new combination. It could not now be transferred to *Gentiana*, as it would form an illegitimate homonym.

House (1924) recognized three subgenera in his treatment of *Gentiana* in New York, two of which would no longer be included in *Gentiana*. The third, subgenus *Dasystephana*, was evidently equivalent to much of the present circumscription of *Gentiana*. *Dasystephana* Adans. (pro gen.), indicated to be the basionym, had comprised only *G. asclepiadea* L. when established by Adanson (1763); this species, therefore, must be regarded as the type species of *Gentiana* subgenus *Dasystephana* (Adans.) House. This name is illegitimate, having been antedated by *Gentiana* sect. *Dasystephana* Griseb., applied (Grisebach, 1845) to a section comprising only the species now known as *Gentianella thyrsoidea* (Hook.) Fabris. House's inclusion of *Pneumonanthe* Gilib. among the synonyms of *Gentiana* subgenus *Dasystephana* indicates that this name is also superfluous, as a later synonym of *Gentiana* subgenus *Pneumonanthe* Raf.

Holub (1970), who restricted *Gentiana* to five species, divided the genus into two subgenera, subgenus *Gentiana*, consisting of *G. lutea* only, and subgenus *Coilantha* (Borkh.) Holub. Subgenus *Coilantha* was based on *Coilantha* Borkh. (pro gen.), to which Borkhausen (1796) had assigned only *G. purpurea*. Since Holub's *Gentiana* subgenus *Coilantha* included both cotypes of Rafinesque's subgenus *Pleuroglossa*, the latter name should have been adopted.

EXCLUDED NAMES

The names listed below were originally published as the names of sections or subgenera of *Gentiana*. However, since none of the species included in the original circumscriptions of these taxa would now be placed in *Gentiana*, and since the epithets (except for *Gentianella*) have not otherwise been associated with species included in the present circumscription of this genus, these names have not been discussed in this paper. The genus to which each of these taxa would now be referred is given following the name. The names of genera segregated from *Gentianella* s. lat. have been employed for the sake of clarity, although I do not accept the generic status of all these segregates without reservation.

[Sect.] *Amarella* Gaudin, Fl. Helv. 2:270. 1828. = *Gentianella*.

Subgenus *Amarelloides* Torr. & Gray ex A. Gray, Man. ed. 1 p. 358. 1848. = *Gentianella* and *Gentianopsis*.

Sect. *Andicola* Griseb., Gen. Sp. Gentianearum p. 213. 1838 ["1839"]. = *Gentianella*.

Sect. *Antarctophila* Griseb., Gen. Sp. Gentianearum p. 235. 1838 ["1839"]. = *Gentianella*.

Subgenus *Anthopogon* (Raf.) Toyokuni, Hokuriku J. Bot. 6:33. 1957, pro syn. = *Gentianopsis*.

Sect. *Arctophila* Griseb., Gen. Sp. Gentianearum p. 250. 1838 ["1839"]. = *Gentianella*.

[Sect.] *Chionanthe* Gaudin, Fl. Helv. 2:270. 1828. = *Comastoma*.

Sect. *Comastoma* Wettst., Oesterr. Bot. Z. 45:174. 1896. = *Comastoma*.

[Sect.] *Crossopetalae* Froel., De Gentiana libellus p. 109. 1796. = *Gentianopsis*.

Sect. *Dipterospermum* (C.B. Clarke) Marquand, Bull. Misc. Inform. 1931:69. 1931. = *Crawfurdia* and *Pterygocalyx*.

Sect. *Dasystephana* Griseb. in DC., Prodr. 9:117. 1845. = *Gentianella*.

[Sect.] *Endotrichae* Froel., De Gentiana libellus p. 86. 1796. = *Comastoma*, *Gentianella*, and *Lomatogonium*.

Subgenus *Eublephis* Raf., Med. fl. 1:208. 1828. = *Gentianopsis*.

[Sect.] *Eyrythalia* (Borkh.) Dumort., Florula Belg. p. 51. 1827, "*Eurytalia*," sensu Dumortier, non [sect.] *Erythaliae* Bunge, nec sect. *Eurythalia* (D. Don) Griseb. = *Gentianella*.

[Sect.] *Gentianella* (Borkh.) Dumort., Florula Belg. p. 51. 1827, sensu Dumortier. = *Gentianopsis*.

[Subgenus] *Gentianella* Reichenb., Herbarienbuch p. 133. 1841; Kusn., Trudy Imp. S.-Peterburgsk. Bot. Sada. 13:58. 1893, superfluous comb. = *Comastoma*, *Gentianella*, *Gentianopsis*, and (sensu Kusnezow) *Megacodon* and *Pterygocalyx*.

Subgenus *Gentianopsis* (Ma) Toyokuni, Hokuriku J. Bot. 6:33. 1957. = *Gentianopsis*.

Sect. *Imaicola* Griseb. in DC., Prodr. 9:94. 1895. = *Gentianella*.

Sect. *Megacodon* Hemsley, J. Linn. Soc., Bot. 26:137. 1890. = *Megacodon*.

Sect. *Stylophora* C.B. Clarke in Hook. fil., Fl. Brit. India 4:118. 1893. = *Megacodon*.

Subgenus *Stylophora* (C.B. Clarke) Toyokuni, Symb. Asahikawenses 1:143. 1965. = *Megacodon*.

Sect. *Tripterospermum* (Blume) Marquand, Bull. Misc. Inform. 1931:70. 1931. = *Tripterospermum*.

[Sect.] *Urananthe* Gaudin, Fl. Helv. 2:270. 1828. = *Gentianopsis*.

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SYNOPSIS OF *KOCHIA* (CHENOPODIACEAE) IN NORTH AMERICA

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ABSTRACT

Kochia in North America as revised includes three species, two native and one introduced. A historical summary of work on the genus in North America is presented, and typification, distribution, and systematics of the species are discussed. Specimens from each county recorded are cited for the native species.

As with most genera of Chenopodiaceae in North America, *Kochia* has long been neglected taxonomically and has become a persistent source of error. Not only are misidentifications frequent in herbaria, but doubt has continued to exist as to the number of taxa that should be recognized, the rank they should be assigned, and the distributional pattern they exhibit; nomenclatural questions also exist. It is toward solution of these problems that the present study is directed.

Kochia was described by Roth in 1800 based on a single European species, *K. arenaria* (= *K. laniflora*, cf. *Flora Europaea* 1: 99). Since 1800, additions to the genus have been substantial; Airy Shaw (1973) provides the recent estimate of 90 species, these occurring primarily in Europe, Asia, and Australia. The complement of species found in North America is small, and consists of both native and introduced elements.

Kochia first received serious taxonomic attention in North America in 1874 when Watson described two taxa: *K. americana* [var. *americana*] and *K. americana* var. *vestita*. Later (1882), Watson described a second native species, *K. californica*. In 1906, Rydberg added yet another by elevating Watson's var. *vestita* to the level of species without explanation. The next milestone for the genus in North America was Standley's revision (1916), incorporated in his treatment of the Chenopodiaceae in *North American Flora*. Standley recognized four species: *K. americana*, *K. vestita*, *K. californica*, and the introduced *K. scoparia*; he recognized no varieties.

Most floristic treatments of *Kochia* in the United States have accepted the conclusions of Standley's revision. A few exceptions are apparent, however. Weber (1972), in his *Rocky Mountain Flora*, suggested that *K. iranica* Bornmueller is a conspicuous component of the Colorado flora and that it has been confused with *K. scoparia*. However, we have studied one of Weber's collections, *Weber 12991* (GH, UC), of "*iranica*" and find it to be

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merely another specimen of *K. scoparia*. In fact, no specimens identifiable as *K. iranica* turned up in any of the North American collections we examined. It is thus our conclusion that *K. iranica* is not a part of the flora of the United States. *Kochia hirsuta* Nolte, reported by Davis (1952) as introduced in Idaho, is probably not a *Kochia*. The short-conic tubercles or spines of the calyx indicate that it is more likely *Bassia*. We have examined the type of *Kochia alata* Bates; it is just another specimen of *K. scoparia*. The varieties of *K. scoparia* recognized by Steyermark (1963) seem unwarranted as intergradation between them is continuous and geographic pattern lacking.

Although several genera of Chenopodiaceae in North America have a similar appearance, we encountered the greatest difficulty, particularly at the outset, distinguishing *Kochia* from *Suaeda*. However, we now know that several characteristics are reliable. The embryo of *Kochia* is annular and usually associated with endosperm; *Suaeda's* embryo is spirally coiled, the endosperm lacking. In the absence of good embryos, distinction can still be made. *Suaeda* has three scarious bracts subtending each axillary flower or flower group, these in turn subtended by a leaf or larger herbaceous bract; in *Kochia*, scarious bracts are lacking. *Kochia* stems (native species) are generally floriferous or potentially so throughout their length; in *Suaeda*, the flowers are usually restricted to distal inflorenscences of various sorts. The calyx of *Kochia* is cleft no more than half way to the base, while that of *Suaeda* is cleft nearly to the base. Finally, in *Kochia* distinct transverse wings develop on the back of the calyx lobes in fruit, a feature usually (though not always) lacking in *Suaeda*. Number of flowers per leaf axil and alternate vs. opposite leaves (Davis, 1952), will not provide separation between these genera. The number of flowers per leaf axil in *Kochia* is 1–3(–5) and in *Suaeda* is 1–3(–9). In both genera the leaves are typically alternate. We acknowledge Mrs. Christine O. Hopkins for her assistance in distinguishing these two genera.

To determine the number of taxa of *Kochia* occurring in North America (including introduced, naturalized taxa), the rank they should be assigned, their distribution, and their typification, North American specimens were studied from the following herbaria: A, F, GH, MO, MU, TEX, UC, US, and UT. For comparison, Old World specimens were examined from MU, TEX, UC, and UT. Australian collections were borrowed from MO and US. We acknowledge the curators of these herbaria for their cooperation in loaning *Kochia* specimens. In the species treatments, based on our herbarium and literature study, only those synonyms causing confusion in North America are listed, in addition to basionyms.

GENERIC DESCRIPTION

Annuals, perennial herbs (often woody at the base), or subshrubs. Leaves mostly alternate, flat or terete, sessile or petiolate. Flowers small, sessile, 1–5 per axil, bisexual or unisexual (native U.S. species often polygamous),

in terminal leafy spikes or the entire branches floriferous; scarious bracts lacking; calyx 5-lobed, cleft not more than half way to the base, developing dorsal, horizontal, membranous wings in fruit; corolla lacking; stamens 5, usually exserted; stigmas 2 or 3. Utricle depressed-globose, closely surrounding but not attached to the seed, eventually disintegrating. Seed horizontal and occupying most of the space within the utricle, remaining more or less enclosed in the calyx; embryo annular around the scanty to copious endosperm.

SPECIES OF *KOCHIA* IN NORTH AMERICA

A. Annuals; leaves often petiolate, thin and flattened; flowers restricted to terminal leafy spikes or spaced along the branches; fruiting calyx wings 0.4–1 mm long, to 1.5 mm broad . . . . . 1. *K. scoparia*

A. Perennials; leaves sessile, terete or essentially flattened; branches potentially floriferous throughout; fruiting calyx wings 1.3–2.5 mm long, 2.5–4 mm broad.

B. Plants paniculately branched throughout, the pubescence brownish (at least on herbarium specimens); leaves more or less flattened (only slightly fleshy), 1.25–3.25 mm broad . . . . . 2. *K. californica*

B. Branching restricted to the base, the branches ascending, frequently simple; pubescence white or grayish or virtually lacking; leaves terete or subterete, 0.5–1.25 mm broad . . . . . 3. *K. americana*

1. KOCHIA SCOPARIA (L.) Schrader, Neues Journal für die Botanik 3(3): 85. 1809.

Chenopodium scoparia L., Sp. Pl. 1: 221. 1753.

Kochia alata Bates, Amer. Bot. 24: 52. 1918. (Type: *Bates 6767* US !).

Glabrous to puberulent or villous, branching annual, often turning red in Fall. Leaves petiolate to subsessile, lanceolate or oblanceolate to linear, 3–70 mm long, 0.5–7.5 mm broad, thin and flattened, not at all fleshy. Flowers sessile, in short, leafy spikes or spaced along the branches; anthers 0.5–1 mm long; calyx 1–2 mm long, the lobes 0.5–1.5 mm broad, in fruit developing membranous wings 0.4–1 mm long and up to 1.5 mm broad. Seed 1–1.8 mm broad.

Kochia scoparia, introduced from Europe as an ornamental, has escaped from cultivation in the United States, becoming naturalized in a number of localities. It could be expected to occur anywhere in the United States as a weed along roadsides or in waste places except in the Southeast. It has doubtless been cultivated for its red foliage, hence the name "fire-bush" or "burning-bush."

Variation is extensive in *K. scoparia* and has led to the proliferation of both species and varietal names. In attempting to account for the variation of *K. scoparia* in Missouri, Steyermark (1963) recognized three varieties: var. *culta* Farw., with thread-like leaves; var. *pubescens* Fenzl, with broader leaves and downy stems; and var. *scoparia*, with broader leaves and sparsely hairy to glabrous stems. We have encountered these and other "forms" of *K. scoparia* in our examination of specimens, but we find the variation to be essentially continuous and distinct geographical patterns

lacking. We do not see the necessity or even the advisability of formalizing the variation encountered in North America with infraspecific Latin epithets.

2. KOCHIA CALIFORNICA S. Watson, Proc. Amer. Acad. Arts 17: 378. 1882.
K. americana var. *californica* M. E. Jones, Contr. W. Bot. 11: 19. 1903.

Brownish, sericeous perennial from a woody base, paniculately branched throughout, the branches spreading or ascending, often striated. Leaves sessile, flat or somewhat fleshy, 2.5–17 mm long, 1.25–3.25 mm broad, densely hispid or sericeous, the apex more or less acute. Flowers axillary, solitary or in clusters of 2–5, often tomentose; anthers 0.5–1 mm long; calyx 1–2 mm long, the lobes 0.5–1.3 mm broad, becoming winged in fruit, the wings 2–2.5 mm long and 2.5–3 mm broad. Utricle pubescent, the seed ca. 2 mm in diameter.

TYPIFICATION: In connection with his original description, Watson (1882) cited two collections without preference: *Parry* [*275*], "near Colton;" and *Parish* [*1348*], "at Rabbit Springs, San Bernardino County." By citing the type locality as "Near Colton," Standley (1916) in effect preferenced the Parry collection as lectotypic. Whether or not Standley meant to make this choice is nomenclaturally irrelevant. Regardless, we have found no reason to overturn his lectotypification. Since duplicates of *Parry 275* exist in at least two herbaria (GH, F 134932), and since neither Standley nor anyone else has selected one as the lectotype, it would seem appropriate to do so herein. The Field Musum specimen is a mixed collection, *Parish 1348* (F 134882) occupying the left side of the sheet and a fragment of *Parry 275* the right. Although bearing the same collection number as the Gray Herbarium specimen, the label of the Parry collection reads "Mojave, California," rather than Colton. On the other hand, the Gray Herbarium specimen of *Parry 275* is more ample (two good branches on the sheet), it is not a mixed collection, and the label clearly states "Colton." Thus, the Gray Herbarium specimen seems preferable as the lectotype, and we so designate it. It is moot to nomenclatural considerations that Colton may in fact be an erroneous locality. Mojave is more likely the actual collection cite since Colton is cismontane. It is interesting, and puzzling, that *Parry 275* is the only collection, among all the *K. californica* specimens we examined, found to be in the fruiting condition, although a number of flowering specimens have been collected.

DISTRIBUTION: *Kochia californica*, more restricted in its distribution than the other native species, *K. americana*, appears to be limited to southeastern California and adjacent southwestern Nevada. The localized distribution, coupled with the dearth of fruiting specimens, led us initially to suspect that it was an introduced species, perhaps persisting locally, but not setting seed. Australia was considered as a possible source of introduction. However, our study of Australian and Old World *Kochia* specimens revealed no other species closely similar to *K. californica*. Dr. Paul G. Wilson of the Western Australian Herbarium, who has recently completed a manuscript

on *Kochia* in Australia, was kind enough to confirm our judgment in this matter based on color transparencies of herbarium specimens of *K. californica*, which we supplied him. Our appreciation is extended to Dr. Wilson for his assistance in the solution of this problem. We can only continue to conclude that *K. californica* is a native to North America, and that it does not occur elsewhere.

SPECIMENS EXAMINED (At least one specimen from each county recorded in our study is cited): CALIFORNIA: Fresno Co.: 9 mi S of Kerman, *Hoover 2325* (US); alkaline plains, 2.5 mi E of Tranquility Junction, along California hwy. 180, *Bacigalupi, Wiggins* and *Ferris 2670* (GH, UC). Inyo Co.: Shoshone, *Grinnell s.n.* (UC). Kern Co.: near Bakersfield, *Rogers s.n.* (UC); Rio Bravo, Buena Vista Lake, *Short 288* (UC). Los Angeles Co.: Lancaster, Antelope Valley, *Abrams* and *McGregor 509* (GH, US); Lancaster, *Elmer 3717* (F, MO, US); uncultivated alkaline area 5 mi W of Lancaster on Antelope Valley Road, *Ferris* and *Rossbach 9475* (F, UC). Madera Co.: 4 mi SW of Chowchilla, *Hoover 2567* (UC, US); 16 mi from Madera on Firebaugh Road, *Hoover 2619* (UC, US); San Joaquin Valley, *Kennedy s.n.* (UC). San Bernardino Co.: 3.5 mi SE of 15 Mile Pt., *Axelrod 337* (UC); dry lake bed, Rabbit Springs, Mojave Desert, *Jepson 5938* (UC); Victor, *Jones s.n.* (MU); Barstow, *Jones 387* (GH); Victor, *Palmer 224* (US); sandy arid hillside of Victorville, Mojave Desert, *Wheeler 2077* (UC); Desert Wells, Mojave Desert, *Purpus 5731* (UC, US). NEVADA: Nye Co.: 0.5 mi E of house on Ash Meadow Ranch, *Coville* and *Funston 369* (US).

3. KOCHIA AMERICANA S. Watson, Proc. Amer. Acad. Arts 9: 93. 1874.
K. americana var. *vestita* Watson, loc. cit.
K. vestita (Watson) Rydberg, Flora of Colorado 119. 1906.

Glabrate to gray-white hispid or sericeous perennial with more or less erect and often simple branches originating at or near the woody base, the branches frequently stramineous. Leaves fleshy, terete or subterete, 4–25 mm long, 0.5–1.25 mm broad, sessile. Flowers axillary, solitary or in groups of 2 or 3, often pubescent; anthers 1–1.5 mm long; calyx 2–2.5 mm long, the ovate lobes 1.3–2 mm broad, crenately winged in fruit, the mature membranous wings 1.3–2.5 mm long and 2.5–4 mm broad. Utricle glabrate to villous, the seed 1–1.8 mm broad.

TYPIFICATION: Watson (1874), in his protologue, cites the following collections: *Torrey 465*, *Watson 992*, *Green s.n.*, and *Wheeler s.n.* These should be regarded as syntypic collections. As in the case of *K. californica*, Standley (1916) effected lectotypification of *K. americana* by citing "Western Nevada" as the type locality. Only the Torrey collection (from Humboldt Mountains, Nevada) fits this locality, and since the only specimen of *Torrey 465* we have been able to locate is at the Gray Herbarium, we accept it as lectotype of the name *K. americana* var. *americana*. Unfortunately, it occurs on the same herbarium sheet with *Watson 992*, *Wheeler s.n.*, and an additional specimen collected by Parry (*Parry 260*). However, this should not preclude its service as lectotype.

Following his description of *K. americana* var. *vestita*, Watson listed two specimens: *Watson 991* and *Burgess s.n.* When Rydberg (1906) elevated variety *vestita* to a species, he did not specify a type. Once again we must look to Standley who, by indicating the type locality as "Shores of Great Salt Lake, Utah," was wittingly or unwittingly choosing a lectotype collec-

tion, *Watson 991*. The *Burgess* collection is probably from Nevada. We have seen the U.S. National Herbarium specimen of *Watson 991* (US 63408) and designate it as lectotype of the name *Kochia americana* var. *vestita* (isolectotype GH, but mixed with the Burgess collection).

The type of var. *vestita* is merely one of many variably pubescent individuals of *K. americana* we have seen, the variation being essentially continuous. We do not believe that this random variation in pubescence should be accorded varietal status, much less that of a species.

DISTRIBUTION AND SYSTEMATIC CONSIDERATIONS: *Kochia americana*, known as green-molly or gray-molly, has a much broader distribution than *K. californica*. According to our herbarium studies, *K. americana* ranges from southwestern Wyoming, southwestern Idaho, and southeastern Oregon, through Utah and Nevada, to southeastern California, northeastern Arizona, western Colorado, and southern New Mexico. Unlike *K. californica*, fruiting specimens of *K. americana* are frequent throughout its range.

Prior to Watson's description of *K. americana*, specimens in American herbaria were usually identified as *K. prostrata* Schrader, a broadly distributed Eurasian species. This, for example, was the case with *Watson 991* (the type of var. *vestita*). It remains to be finally demonstrated just how distinct *K. americana* and *K. prostrata* are. Watson (1874) suggests the following rather technical characters for separation: the pubescence of the utricle, the amount of albumin, and the prolongation of the radicle sheath. Dr. Paul G. Wilson of Australia has agreed that *K. americana* and *K. prostrata* are similar, but has declined to pronounce on their synonymy in the absence of more information about *K. prostrata*. Though *K. americana* and *K. prostrata* are unquestionably similar, we believe them to be distinct species based on habit, geographical distribution, and the characters discussed by Watson.

SPECIMENS EXAMINED (At least one specimen from each county recorded in our study is cited): ARIZONA: Apache Co.: 9 mi NE of Rock Point, *Peebles* and *Smith 13539* (US). Navajo Co.: near Agathla, *Eastwood* and *Howell 6634* (US). CALIFORNIA: Inyo Co.: Death Valley, Darwin Mesa, on road from Kieler to Darwin, *Coville* and *Funston 905* (GH, MO, US); open dry flats of hwy. 190, 5 mi E of road to Darwin, *Muntz 11739* (UT); Death Valley region, W side of Funeral Range, Boundary Canyon, *Wolf 6661* (GH). Lassen Co.: Honey Lake Valley, *Davy 3329* (UC). San Bernardino Co.: Barstow, *Brandegee* (UC). COLORADO: Mesa Co.: Gunnison watershed, Grand Junction, *Baker 928* (GH, MO, UC); Colorado National Monument, 3 mi S of Fruita, W of hwy. approach to monument, *Weber 3770* (TEX, UC). IDAHO: Owyhee Co.: Sinker Creek, Idaho Range 1. West, Township 3 South, *Davis 2113* (F). NEVADA: Churchill Co.: Fallon, *Tidestrom 10771* (F). Elko Co.: Battle Mts., *Kennedy 3078* (MO). Esmeralda Co.: Pinyon Hill, *Duran 2867* (UC); 1 mi N of Goldfield along Tonopah hwy., *Train 3441* (UC). Humboldt Co.: Humboldt Lake, *Jones 4057* (MO, UC, US); greasewood desert 30 mi W of Battle Mountain, *Bassett*, *Ruth*, and *C.B. Maguire 5871* (GH). Lander Co.: mouth of Birch Creek Canyon, 14 mi from Austin, *Henning 78* (F, MO, UC); Eastgate, *Train s.n.* (MU). Lincoln Co.: Cathe-

dral Gorge State Park, 3 mi NW of Panaca, *Train 2480* (UT). Lyon Co.: 6 mi SE of Rockland, Wellington, *Hendrix 644* (UC). Mineral Co.: near reservoir at head of Pickhandle Gulch, *Ferris 13106* (GH, UC); 2 mi S-SW of Sonoma, Bridgeport, *Graham 281* (UC). Nye Co.: 2 mi NW of Penelas Mill, 15 mi NW of Ione, *Beach 818* (UC, US); 2 mi below mouth of the north fork of Twin Rivers, *Henning 100* (UC). Washoe Co.: 20 mi E of Reno, *Archer 6231* (F, MO, UC); northern base of Granite Range, 1.5 mi NE of Gerlach, *Bacigalupi 5917* (UC). White Pine Co.: 26 mi SW of Ely, *Davis D2619* (UT). NEW MEXICO: Dona Ana Co.: Mesquite, roadside, Lower Sonoran Zone, *Fosberg S3452* (GH). OREGON: Harney Co.: Island Ranch, near Burns, *Griffiths* and *Morris 720* (MO); Narrows, *Peck 1657* (GH). Malheur Co.: forks of Malheur, *Cusick 1111* (US). UTAH: Box Elder Co.: *Garrett 5389* (F, UT). Emery Co.: hillsides of East Ferron, *Cottam 5200* (UT). Juab Co.: 3 mi W of Trout Creek, *Maguire* and *Becraft 2574* (MO). Millard Co.: Painter Spring, *Fautin 8931* (F); Milford, *Jones 1491* (A, F, US). Piute Co.: along Sevier River, *Rydberg* and *Carlton 6929* (US). Salt Lake Co.: near Garfield, *Flowers 952* (UT). San Juan Co.: 0.5 mi E of Mounts and Jaques Trading Post, 3 or 4 mi W of Hovenweep National Monument, *Cutler 2757* (GH, MO). Sevier Co.: Glenwood, *Ward 154* (MO, US). Tooele Co.: Stansbury Island, Great Salt Lake, *Garrett 5357* (F); W of Grantsville, *Harris C2056* (MO). Utah Co.: near railroad track between Bringhurst and Lehi, *Garrett 5206* (F, UT). Uintah Co.: desert SE of Jenson, *Graham 8297* (F). Washington Co.: Valley of Virgin, near St. George, *Parry 224* (GH, MO, US). Wayne Co.: Blue Valley, *Stanton 515* (UT). WYOMING: Carbon Co.: Fort Steele, *Tweedy 4496* (US). Sublette Co.: plains between Eden and Big Piney, *E.* and *L. Payson 2590* (MO, UC). Sweetwater Co.: Rock Springs, *Degener* and *Reiler 16101* (MO); Point of Rocks, *Merrill* and *Wilcox 649* (GH, US). Uinta Co.: near Hampton, *Patterson* and *Beaty s.n.* (F).

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SEED CHARACTERS IN SOME NATIVE AMERICAN VETCHES[1]

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INTRODUCTION

Hermann (1960) and Gunn (1965, 1970, 1971) have used seed characters for identifying species of *Vicia* (vetch). Hermann used the relative hilum length, which is a percentage figure calculated as hilum length/seed circumference × 100. Gunn (1970) lists four seed characters as being reliable in identification: seed circumference, relative hilum length, hilum shape, and relative position of the lens to the hilum. The lens or strophiole is a protuberance or swelling on the seed margin between the hilum and chalaza and is derived from integumentary tissue (Kopooshian and Isely, 1966).

The relationship of *Vicia ludoviciana* Nutt., *V. leavenworthii* T. & G., *V. exigua* Nutt. and the varieties of each have been interpreted differently by recent workers (Shinners, 1948; Turner, 1956; Isely, unpublished manuscript; Lassetter, 1972). During a taxonomic study of this native complex occurring from Alabama to California, and northern Mexico into the Rocky Mountains, Lassetter (1972) examined seed characters to evaluate their taxonomic usefulness. The features studied were relative hilum length, seed diameter (substituted for circumference because the seeds are essentially spherical), hilum shape (determined by measuring the hilum width at each end), color of testa, and color of mottled portion of testa (if present). The distance between the lens and hilum was not measured because it is essentially identical in these vetches.

MATERIALS AND METHODS

A total of 60 seed samples was analyzed. Except for four samples, each one contained field-collected seeds from many plants of a single population. The samples, then, were collected from populations and were not just seed from a single plant. The remaining four samples were obtained from greenhouse specimens grown from seeds taken from herbarium sheets.

Each sample was poured into a petri plate with 25 evenly spaced marks,

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Table 1. Relative hilum lengths in the *V. ludoviciana* complex.

Taxon	Hermann (1960)	Gunn (1965, 1971)	Lassetter	Number of samples
V. ludoviciana var. *ludoviciana* (= defunct var. *typica*)	25—33	30	25.9—37.9	16
V. ludoviciana var. *laxiflora*		none given	16.2—21.8	5
V. ludoviciana var. *texana*		23	17.7—25.8	15
V. leavenworthii var. *leavenworthii* (= defunct var. *typica*)	ca. 25	22	19.0—22.6	16
V. leavenworthii var. *occidentalis*		19—21	10.0—14.7	4
Louisiana type			45.6	1
V. exigua var. *exigua*	20	14—17	19.5—21.6	3

and data were taken from the 25 seeds on or nearest the marks. Observations were made at 10x or 20x through a stereoscopic microscope equipped with an ocular micrometer. Measurements were recorded to the nearest 0.1 mm except for hilum width, which was recorded to the nearest 0.01 mm.

The colors were subjectively observed and numerically recorded (see Lassetter, 1972).

A correlation coefficient matrix was computed to show related variation between the following: seed diameter, relative hilum length, hilum length, hilum width at wide end, hilum width at narrow (lens) end, base color of testa, and color of mottling. Means of the data were used as input. The longitude and latitude of the mass collection site were also entered as data to determine if any correlation between site and seed characters existed.

RESULTS AND DISCUSSION

Table 1 contains the relative hilum length as reported by Hermann (1960), Gunn (1965, 1971), and from this study. Values from Hermann (1960) are for species only. In Gunn's data, values for *V. ludoviciana* var. *ludoviciana* and *V. leavenworthii* var. *leavenworthii* are from Gunn (1971); values for other taxa are from Gunn (1965). The number of samples refers to Lassetter's data, which are the minimum and maximum sample means for each taxon. The Louisiana type is a vetch previously recognized as *V. ludoviciana* var. *ludoviciana*, but which has characteristics closely resembling *V. leavenworthii* var. *leavenworthii*, and it was studied as a separate entity.

The names used by Hermann, Gunn, and Lassetter in Table 1 represent the same taxa concept except for one case. *Vicia exigua* var. *exigua* sensu Hermann occurred from California to Texas. *Vicia exigua* var. *exigua* sensu Gunn occurred from California to Arizona, New Mexico, and Utah, and was not present in Texas, the southern Texas plants being assigned to *V. leavenworthii* var. *occidentalis*. *Vicia exigua* var. *exigua* sensu Lassetter occurred only in California; the Arizona, New Mexico, and Utah plants, as well as the southern Texas plants, being assigned to *V. leavenworthii* var. *occidentalis*. Some of the differences in Table 1 between my data and that of previous workers may be due to differences in taxa concept and in application of taxa names.

The overlap of relative hilum length is clearly shown (Fig. 1) when the mean values for each population sample are arranged in graphical form. Three main breaks in the values are present. The Louisiana type is distinct, with 46 percent. All the other samples with values above 30 percent are *V. ludoviciana* var. *ludoviciana*, and only one sample of this taxon was less than 30 percent. The three samples with values of 10–15 percent are *V. leavenworthii* var. *occidentalis*. The largest group of samples falls into the 16–26 percent range and includes all types except *V. leavenworthii* var. *occidentalis* and the Louisiana type.

If a plus-one standard deviation and a minus-one standard deviation of each sample are considered, the resulting overlap of values is great enough

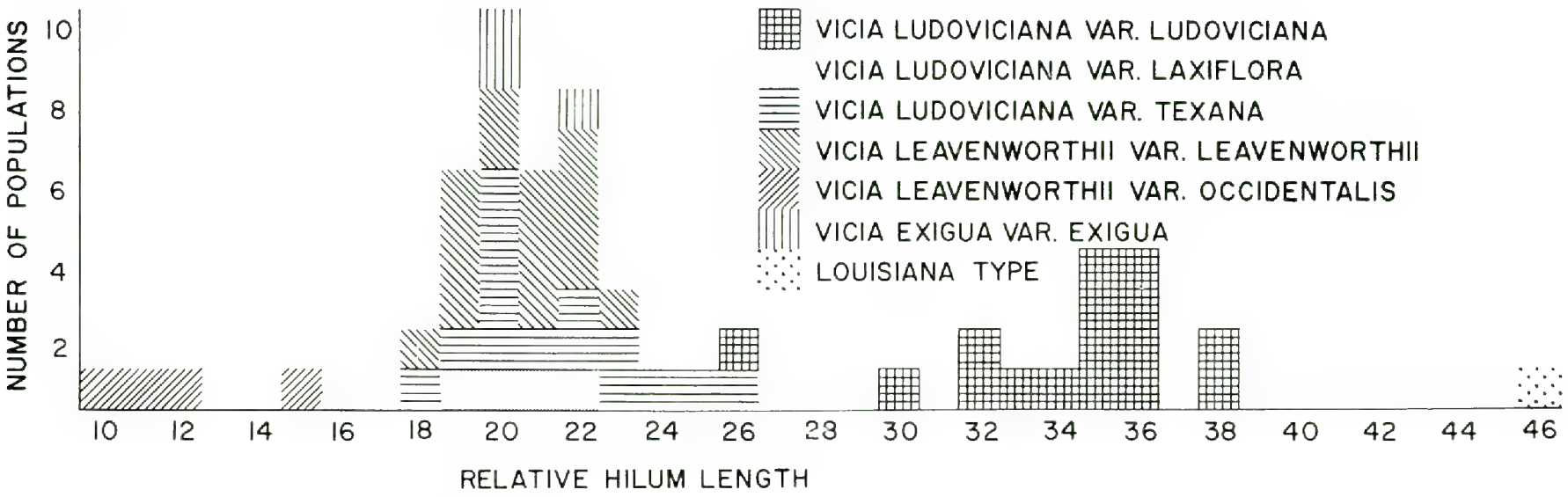

Figure 1. Means of relative hilum lengths.

to produce a continuum of values from 9 percent (*V. leavenworthii* var. *occidentalis*) to 40 percent (*V. ludoviciana* var. *ludoviciana*) (Lassetter, 1972). If the total range of variation in each sample is considered, the breaks in Fig. 1 at 13 percent and 40–45 percent disappear (Lassetter, 1972).

From Table 2, the diameter of most seeds is between two and three mm, with only a few types having larger or smaller seeds. The overlap that exists precludes delimiting these vetches by seed diameter.

Gunn (1970, 1971) gives the hilum shape of *V. ludoviciana* and *V. exigua* as oblong (with parallel sides) and, of *V. leavenworthii*, as wedge (with tapering sides). My data confirm the oblong shape for the first two species, but variation in hilum shape within individual samples of *V. leavenworthii* was observed. Some population samples contained seeds with oblong hila, as well as seeds with wedge-shaped hila. Because of intrapopulational variation, this character is not wholly useful inasmuch as all three species can have oblong hila.

The base color and mottling also varied within individual samples. Some samples were uniformly colored, and others consisted entirely of mottled seeds. Other samples, however, contained a mixture of mottled and uniformly colored seeds. I believe that color variation is not due to the stage of seed maturity, because seeds were collected from plants with completely ripened legumes.

Table 3 contains correlation coefficients of longitude, latitude, and seven seed characteristics. The highest correlation is between hilum length and relative hilum length. This correlation indicates that these two characters are related, but are not dependent on the diameter of the seed, with which they correlate at 0.36 and 0.06, respectively. The wide-end and narrow-end width of the hilum correlate at 0.92. The usefulness of hilum shape was discussed earlier. The wide-end width of the hilum correlates at 0.50 with seed diameter, indicating that hilum width is somewhat related to seed size.

The distribution of the *V. ludoviciana* complex is primarily east-west, and longitude correlated with hilum length and relative hilum length at 0.50 and 0.66 respectively. The samples with the shortest hila and shortest relative hilum length are from the arid southwestern United States. This correlation may indicate an adaptive character of survival value in that environment. Many papilionoid legumes are termed hard-seeded because their seed coats are impervious, and do not imbibe water (Hyde, 1954). The hilum of hard-seeded legumes functions in producing the proper level of seed dessication. Once the moisture content has dropped to about 14 percent, the seed coat becomes impermeable and further dehydration is accomplished by moisture loss through the hilar fissure (Hyde, 1954). A small hilum could be advantageous in reducing excessive moisture loss from seed in extremely arid environments.

According to Gunn (1971), other native North American vetches occurring in the same general xeric areas also have rather small relative hilum lengths: *V. americana*, 20-33%; *V. leucophaea*, 23%; and *V. pulchella*, 26%.

Table 2. Seed diameter in mm.

Taxon	Min.	Minus One S'd. Dev.	Mean	Plus one Std. Dev.	Max.
V. ludoviciana var. *ludoviciana* (= defunct var. *typica*)	1.80	2.08	2.32	2.56	2.68
V. ludoviciana var. *laxiflora*	1.92	1.99	2.17	2.35	2.30
V. ludoviciana var. *texana*	1.80	1.97	2.15	2.33	2.35
V. leavenworthii var. *leavenworthii* (= defunct var. *typica*)	1.92	2.07	2.30	2.53	2.78
V. leavenworthii var. *occidentalis*	2.12	2.09	2.43	2.77	2.90
Louisiana type	2.60	2.62	2.77	2.92	3.30
V. exigua var. *exigua*	2.75	2.67	2.94	3.21	3.23

Table 3. Correlation coefficients of longitude, latitude, and seven seed characteristics.

	Longitude	Latitude	Seed diameter	Base color	Mottling color	Hilum length	Hilum width at wide end	Hilum width at narrow end	Relative hilum length
Longitude	1.00								
Latitude	.37	1.00							
Seed diameter	.34	.43	1.00						
Base color	.24	.01	.01	1.00					
Mottling color	.11	.08	.05	.10	1.00				
Hilum length	.52	.10	.36	.06	.27	1.00			
Hilum width at wide end	.10	.37	.36	.27	.17	.33	1.00		
Hilum width at narrow end	.07	.38	.50	.26	.28	.39	.92	1.00	
Relative hilum length	.66	.02	.06	.03	.32	.94	.22	.27	1.00

Additional native species with a relative hilum length of 75% (*V. acutifolia, V. caroliniana, V. floridana, V. gigantea, V. minutiflora, V. ocalensis*) are mostly of the eastern and southeastern United States, where habitats are more mesic. *Vicia cracca* (33%) is circumpolar, and *V. humilis* (30%) is of wet pine woodlands and meadows of Mexico.

CONCLUSIONS

All the characters evaluated are variable. The overlap between the three species and between varieties within species is evident. In addition, seed coloring and hilum shape varied within individual samples, and because of intrapopulational variation cannot be used effectively to differentiate the taxa.

The relative hilum length and other seed characters may be useful for identification of other groups of *Vicia* species and are valuable in combination with other morphological characteristics for identification purposes. Because of the overlap due to wide variation demonstrated in these characters, I believe it unwise to base identification of taxa in this complex on seed characters alone.

The distribution of most taxa of the complex is centered in a different area (Lassetter, 1972). Portions of ranges often overlap, but the centers of distribution usually do not. Occurrence of the taxa of this complex is in part related to edaphic factors (Shinners, 1948; Turner, 1956; Lassetter, 1972). The intraspecific differences in relative hilum length of varieties may indicate an ecotypic adaptation of those taxa to other nonedaphic environmental factors.

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Mr. Jim Cheek, of the Eastern Kentucky University computer center prepared the correlation matrix.

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BIOSYSTEMATICS OF THE TEXANAE VERNONIAS (VERNONIEAE: COMPOSITAE)[1]

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ABSTRACT. In the most recent monograph of *Vernonia* in North America, this species-group was treated as four species (*V. texana*, *V. greggii*, *V. schaffneri*, and *V. ervendbergii*). Information from ecological observations, comparative morphology, biochemical systematics, transplant studies, hybridization experiments, and geographical distribution is presented and used to establish a new classification. Two species are now recognized in the group: *V. texana*, from the south central United States, and *V. greggii* with four subspecies from the Sierra Madre Oriental in Mexico.

INTRODUCTION

The genus *Vernonia* Schreb. is largely tropical with about 800 to 1,000 species distributed both in the Old and in the New World. Gleason (1906) divided the North American members of section *Lepidoploa* into two subsections and seven series. The species from the eastern United States and northeastern Mexico were included in subsection *Paniculatae* series *Verae*. Gleason recognized a number of species-groups within series *Verae*, each characterized by its own morphological features and geographical distribution. Four species were included in the Texanae species-group: *V. ervendbergii* Gray, *V. greggii* Gray, *V. schaffneri* Gray, all from the Sierra Madre Oriental of northeastern Mexico, and *V. texana* (Gray) Small, from the south-central United States (Gleason, 1906, 1922). The loose inflorescences, the hemispheric to broadly campanulate involucres, and the southwestern distribution characterize this group (Gleason, 1906).

Gleason (1923) suggested that the North American Vernonias could be traced back to an origin in South America. His theory was based on the increase toward the south in the number of species and on what he considered to be the more primitive morphology of the tropical species. He theorized that *Vernonia* followed two migration routes into North America. The eastern route was through the Windward Islands into the Greater Antilles. The western route was through Central America and Mexico into the southwestern United States through Texas and, hence, north into the eastern one-half of the United States. Gleason (1923) believed that the Texanae

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species-group is the most primitive in series *Verae*.

The taxonomic history of the group is not complicated. Torrey and Gray (1841) cited a λ form of *Vernonia angustifolia* Michx. as having leaves which were longer than the α and β form. Also, they recognized the form as occurring in Louisiana and Texas, while the α and β ranged from Florida to North Carolina. Gray (1844) followed the earlier treatment of Torrey and Gray (1841) for *V. angustifolia* var. *texana*. He separated this variety primarily on the shape of the involucral bract tips. Trelease (1888) changed the name of *V. angustifolia* to *V. granienifolia* (sic) var. *texana* in Branner and Coville's (1891) "Plants of Arkansas"; however, *V. gramienifolia* is a later homonym. Kuntze (1891) changed the generic name of *Vernonia* to *Cacalia* and applied the name *C. angustifolia* var. *texana* to a specimen from Cairo, Mississippi, located in the extreme northeastern corner of the state. Twelve years later Small (1903) elevated var. *texana* to the rank of species.

Vernonia ervendbergii and *V. schaffneri* were described as species by Gray (1882) in his "Novitiae Arizonicae". In this same publication Gray recognized two extremes of *V. greggii* as var. *greggii* and var. *palmeri*. Eighteen years later, Gleason (1906) eliminated var. *palmeri*, and in 1937, Standley described *V. taylorae*; a name that has more or less been ignored. Throughout the experimental sections of this study, *Vernonia ervendbergii*, *V. greggii*, *V. schaffneri*, and *V. texana*, are referred to *sensu* Gleason (1922).

There has been a great deal of confusion and uncertainty with regard to the identifications of the three species from Mexico. This lack of understanding is due primarily to their similar morphology and to lack of collections. There also has been some difficulty in identification due to hybridization between *Vernonia texana* and several sympatric species in the United States. The chromosome numbers for *Vernonia greggii* and *V. texana* have been previously reported as n = 17 by Hunter (1964) for the former and by Jones (1970) for the latter. The chromosome numbers of *V. schaffneri* and *V. ervendbergii* have not been previously reported. Experimental hybrids had not been made previously between Vernonias from the United States and Mexico.

The purposes of this study were: (1) to investigate their cytotaxonomy; (2) to determine whether or not the Mexican Texanae could be intercrossed with each other and with other members of series *Verae* native to the United States; (3) to better delimit the geographical ranges of the Mexican taxa; and (4) to develop a taxonomic treatment of the group based upon results from anatomical, biochemical, cytological, ecological, hybridization, and morphological studies.

RESULTS

Anatomy and morphology. The upper and lower leaf blade epidermis, leaf trichomes, leaf venation, leaf anatomy, pollen grains, achenes and pappus were compared among all four taxa (cf. Appendix). The observed

differences in these features were slight among the taxa. Leaves of *Vernonia texana* have two palisade layers whereas the three Mexican taxa have a single palisade layer. The achenes of *V. texana* tend to be densely covered with trichomes whereas the others are not. The anatomy and morphology of the three Mexican taxa are quite similar and in general resemble that found in the other members of subsection *Paniculatae* series *Verae* (Jones, 1972; Urbatsch, 1972; Faust, 1972; King and Jones, 1975).

Chromosome numbers. Acetocarmine squashes of pollen mother cells from 26 collections of the four taxa all yielded n = 17 (cf. Appendix). These additional counts confirm earlier reports (Hunter, 1964 and Jones, 1970) and conform to that found in series *Verae* in eastern North America.

Chemotaxonomy. Flavonoids were examined from 31 populations (cf. Appendix) of these four taxa. There was some variation in compounds among the local populations of *Vernonia texana* but all four taxa have the same flavonoid compounds. The flavonoid variation in *V. texana* seems to be in part geographical and also due to hybridization with other sympatric taxa. The taxa of this study have the greatest number of flavonoid compounds in series *Verae* (Mabry *et al.*, 1975). If reduction in compounds is an advanced feature then the flavonoid evidence supports Gleason's (1923) hypothesis that the Texanae species-group is primitive in series *Verae*. Mabry *et al.* (1975) report that all taxa have the sesquiterpene lactone glaucolide-A.

Experimental hybridizations. Crossing experiments of the Texanae species group with other species in series *Verae* gave 80 to 90% mean pollen stainability in F_1, F_2, and F_3 generations. Details of the 154 crosses attempted in 105 combinations of taxa are reported in Chapman (1973) [Xerox copies are available from G.C.C.]. Generally highly fertile (as indicated by pollen stainability) first, second, and third generation and backcross hybrids were obtained. Some of the progeny from the second and third generation hybrids were weak and had abnormal development similar to that reported by Faust (1972), but no significant hybrid sterility barriers were observed. One of the more significant aspects of this study is that the taxa of series *Verae* from the Sierra Madre Oriental of northeastern Mexico can be crossed with other Vernonias from the eastern United States despite many years of geographical isolation. Hybrids between the Mexican Texanae and members of the Mexican series *Umbelliformes* produced hybrids with ca. 20–25% stained pollen (Jones, 1976).

Morphological analysis of local population samples. Local population samples of ten to twenty-six plants were collected from several locations throughout the ranges of each taxon (see Fig. 1). Twelve morphological characters (see Table 1) were measured on each plant of the population samples and the values obtained were punched onto computer cards. The mean, standard deviation, and range of each character for every population was calculated, using a BMDO2R—Step-wise Regression Program from the Health Sciences Computing Facility, UCLA (April 13, 1965 version). A multivariant, univariant discriminant analysis of irregular data program

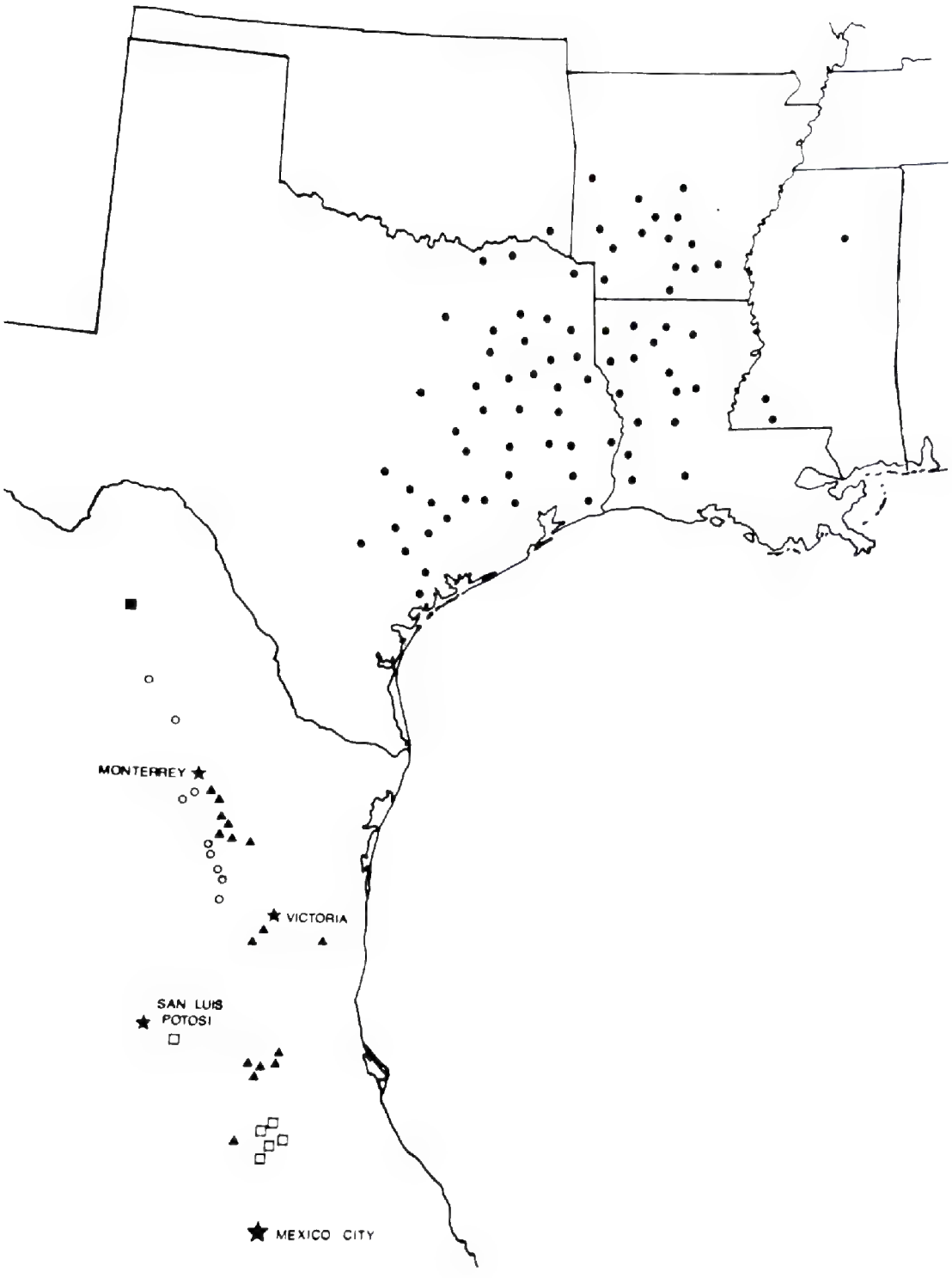

Fig. 1. Distribution of *Vernonia texana* (closed circle); *V. greggii* ssp. *greggii* (open circle), ssp. *ervendbergii* (triangle), ssp. *schaffneri* (open square), and ssp. *faustiana* (closed square).

(MUDAID—6400) written by Dr. R. E. Barghman of the University of Georgia Statistics Department was used to compare these four taxa. Individual populations of a taxon were combined into a single group for the computer analysis. For example, the *Vernonia ervendbergii* group contained 75 individual plants from 3 population samples; *V. greggii*, 100 (4 populations); *V. schaffneri*, 97 (4 populations); and *V. texana*, 389 (18 populations). In addition, the features of each taxon were compared, using dice-grams for each of the twelve characters. Polygonal graphs showing eight characters were constructed for each population and overlaid on or near their collection site on a base map. A hybrid population of *V. texana* was analyzed with scatter diagrams.

It was assumed that much of the variation among the species-group and certain correlations of characters might be better understood if only the three Mexican taxa were analyzed together. Hence, another analysis was made that excluded *Vernonia texana* using the same MUDAID—6400 program as before. The MUDAID program included a canonical test of correlation for each of the twelve morphological characters to each other and a comparison of each character to the standard error.

The results shown in Table 2 indicate that the number of flowers/head is the most useful character to distinguish the populational means of *Vernonia texana*, *V. ervendbergii*, *V. greggii*, and *V. schaffneri*. The next best characteristic is involucre length, followed in decreasing order by inner bract length, involucre width, leaf width, leaf length/width, outer bract length, inner bract width, outer bract width, leaf length, outer bract length/width, and inner bract length/width. When *V. texana* is removed from the statistical comparison, there is a shift in the order of significant characters. For example, in the comparison without *V. texana*, the inner bract is the most significant character and the number of flowers per head dropped to the fourth best character.

The variation pattern in eight characters of 24 populations of *Vernonia texana* from throughout most of its geographical range is shown by poly-

TABLE 1. Morphological Characters Measured or Scored on the Local Population Samples.

Characteristic	Characteristic
(LELT) Leaf length, mm	(IBL) Inner bract length, mm
(LEWI) Leaf width, mm	(IBW) Inner bract width, mm
(LL/W) Leaf length/width	(IL/W) Inner bract length/width
(INLT) Involucre length, mm	(OBL) Outer bract length
(INWI) Involucre width, mm	(OBW) Outer bract width
(FLS) Flowers per head	(OL/W) Outer bract length/width

gonal graphs in Figure 2. Of the eight characters used in the polygons, leaf width and leaf length/width appear to vary the most from population to population. Leaves tend to be narrower in the southeastern part of the range and wider toward the north and northwest. Much intra-populational variation is revealed in the polygons, and no definite geographical correlation is apparent.

The polygonal graphs constructed from sixteen population samples of the three Mexican taxa, *Vernonia ervendbergii*, *V. greggii*, and *V. schaffneri*, are compared in Figure 2. There appear to be no major differences in their basic shape, but there is a considerable difference in the size of the graphs. The eastern side of the Sierra Madre has the smallest polygons, the western side has the largest, and to the south are found the intermediate polygons showing a geographical correlation.

The dice-grams (Figure 3) demonstrate that the ranges of all twelve characters overlap when composite populations of *Vernonia ervendbergii*, *V. greggii*, *V. schaffneri*, and *V. texana* are compared.

The MUDAID computer program produced a table showing correlations based on matrix E (correlation based on corrected Σ from ANOVA) among the twelve characteristics used in the morphological studies. Table 3 presents each character and the five characters most correlated with it for all four taxa, *Vernonia texana*, *V. ervendbergii*, *V. greggii*, and *V. schaffneri*. Those characters showing a value of .500 or higher are considered significant and are underlined. The inner bract length shows a correlation between

TABLE 2. F *vs.* Standard Error for Characteristics Measured on Local Populations of the Texanae Species—Group of *Vernonia*.

Mexican Taxa		Mexican Taxa + *V. Texana*	
Character*	F Value	Character*	F Value
IBL	197.6	FLS	750.3
INWI	193.4	INLT	613.8
INLT	181.3	IBL	368.0
FLS	169.7	INWI	365.1
OBL	144.0	LEWI	305.4
LL/W	89.4	LL/W	192.6
LELT	67.6	OBL	155.9
OBW	60.9	IBW	103.6
IBW	27.6	OBW	70.6
LEWI	17.9	LELT	54.2
IL/W	17.5	OL/W	16.0
OL/W	13.0	IL/W	10.0

* Refer to Table 2 for explanation of abbreviation.

the involucre width, inner bract width, inner bract length/width, and outer bract length; the inner bract width to the inner bract length/width and the outer bract length to the outer bract width.

Natural hybridization between *Vernonia texana* and *V. baldwinii* is documented by scatter diagrams in Figure 4. The hybrid population sample (15843) includes some of both parental types and many intermediate forms. Putative backcrosses were also recognizable within the population. Artificially produced F_1 hybrids (crosses 10C, 11C) are morphologically intermediate between the two parental types, *V. texana* (15839) and *V. baldwinii* (15841).

The morphological analysis of the local population samples indicates that *Vernonia ervendbergii*, *V. greggii*, and *V. schaffneri* are related to *V. texana*; however, *V. texana* can be easily distinguished from the other three taxa. The smaller number of flowers per head and the narrow-linear to narrow-lanceolate leaves of *V. texana* are the most useful key characters for separating *V. texana* from the three Mexican taxa. It is not possible to clearly separate the three Mexican taxa from each other with morphological features.

The morphological characters evaluated for the local population samples of *Vernonia texana* vary in their mean values as shown by the polygonal graphs. This variation can be expected since the taxon ranges over a rather

TABLE 3. Correlation of the Five Most Correlated Characteristics Based on Matrix E for *Vernonia ervendbergii*, *V. greggii*, *V. schaffneri*, and *V. texana*.

Character*	Correlation				
	Higher				Lower
LELT	LEWI .388	INWI .133	IBW .108	OBW .102	FLS .092
LEWI	LL/W .492	LELT .388	OBW .320	OBL .276	INWI .232
LL/W	LEWI .492	OBL .265	OBW .261	INWI .196	IBL .160
INLT	IBL .371	OBL .299	FLS .278	OBW .201	LEWI .128
INWI	IBL .509**	FLS .384	OBL .350	LEWI .232	IL/W .212
FLS	INWI .384	INLT .278	OBL .264	IBL .241	OBW .220
IBL	OBL .624	IL/W .539	INWI .509	INLT .371	OBW .313
IBW	IL/W .779	OBW .312	OL/W .248	LEWI .186	FLS .172
IL/W	IBW .779	IBL .539	FLS .396	OL/W .345	OBL .285
OBL	IBL .624	OBW .557	OL/W .397	INWI .349	INLT .299
OBW	OBL .557	OL/W .397	LEWI .320	IBL .313	IBW .312
OL/W	OBL .397	OBW .397	IL/W .345	IBL .277	IBW .248

* Refer to Table 2 for explanation of abbreviation.

** Underlined characters show high correlation.

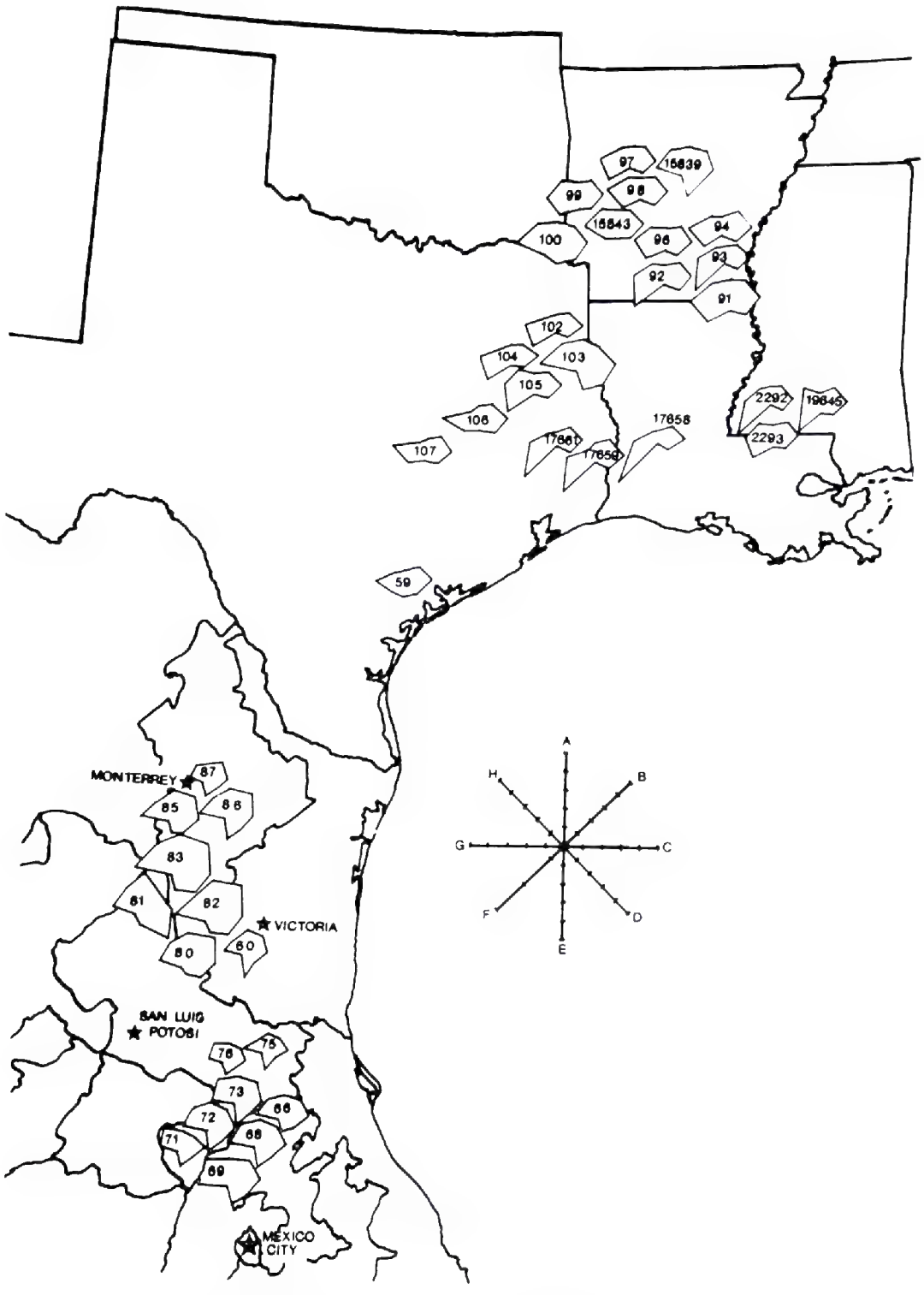

Fig. 2. Polygonal graphs of eight morphological characteristics from local populations of *Vernonia texana* (in U.S.) and *V. ervendbergii*, *V. greggii*, and *V. schaffneri* (in Mexico). The number inside polygon is a collection number (cf. Appendix). Axes represent A, number of flowers per head; B, involucre length (mm); C, inner bract length (mm); D, involucre width (mm); E, leaf width (cm); F, leaf length/width; G, outer bract length (mm); H, inner bract width (mm).

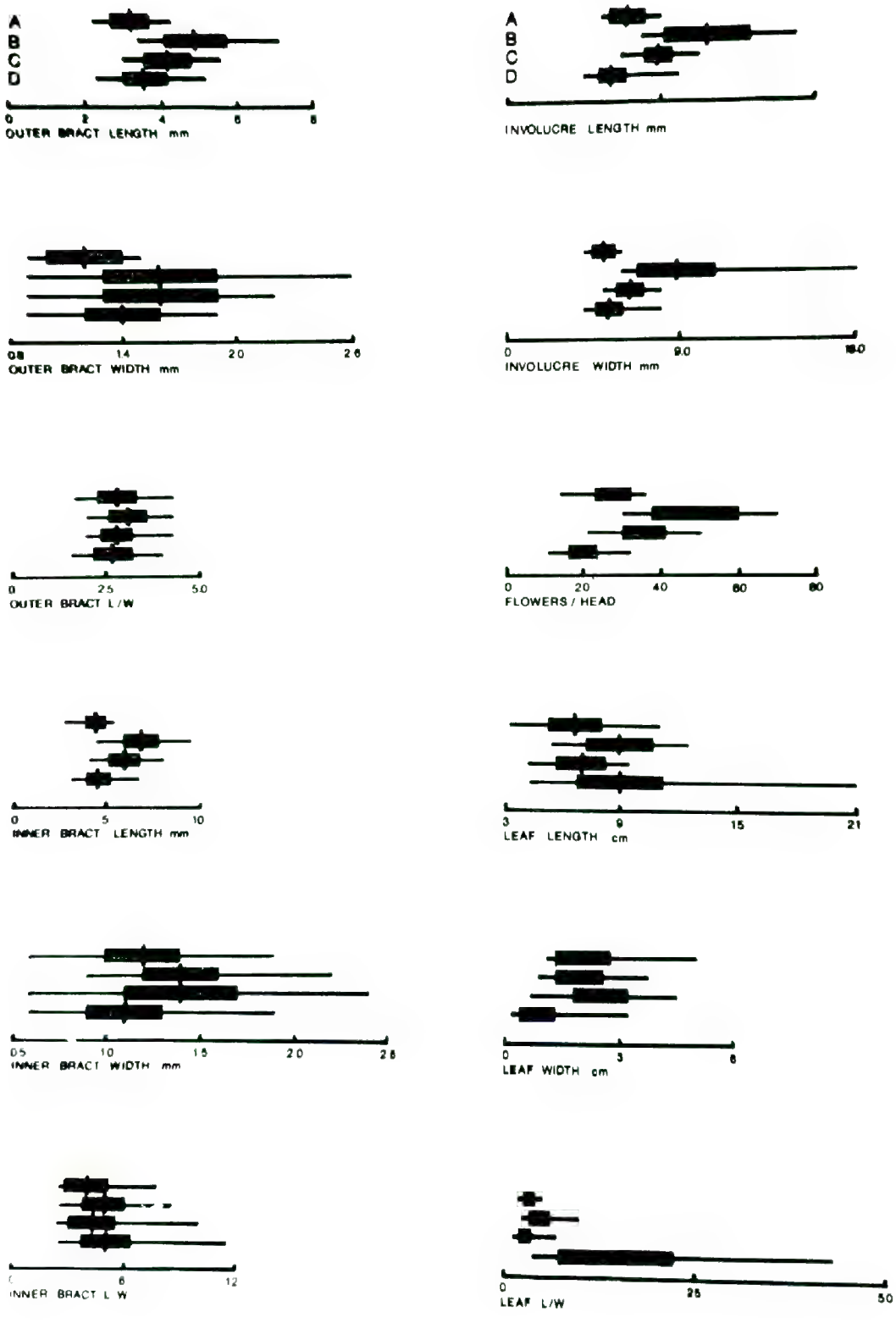

Fig. 3. Mean, range, and standard deviation for selected characters of *Vernonia ervendbergii* (A), *V. greggii* (B), *V. schaffneri* (C), and *V. texana* (D) from combined populations of each taxon.

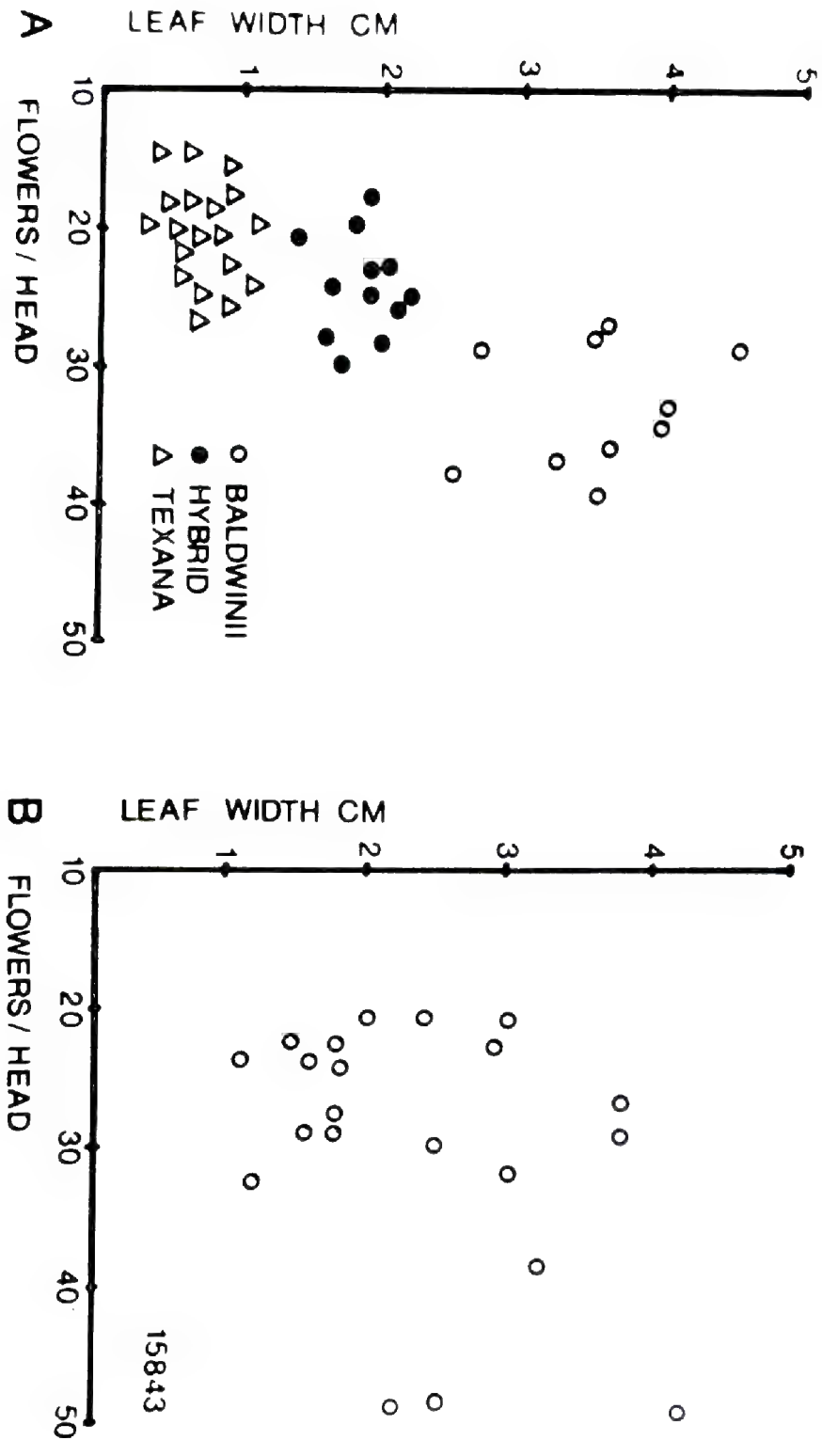

Fig. 4. Scatter diagrams of *Vernonia texana* and *V. baldwinii*. A, typical *V. texana* (15839), artificial F_1 *V. texana* X *V. baldwinii* hybrids (X10C, X11C), and typical *V. baldwinii* (15841); B, local population sample (15843) is a hybrid population which includes putative hybrids and both parental types.

large geographical area but the variation is due to natural hybridization with other sympatric Vernonias.

The eight morphological characters of *Vernonia ervendbergii*, *V. greggii*, and *V. schaffneri* compared in polygonal graphs (see Fig. 2) show some geographical correlation. Although the taxa appear sympatric, the mountainous region where these taxa occur provides diverse habitats. Two populations could be only a few airline miles apart, yet be isolated by a mountain range, with one site being dry and the other wet. The isolation available in the area would allow local populations to diverge, since they are probably not sharing the same gene pool with many adjacent populations.

The hybridization experiments demonstrated that hybridization can occur in the greenhouse and some evidence of natural hybridization is suggested by the polygonal graphs of populations *85* and *86*. These two populations are intermediate in size between those of *V. ervendbergii* (87) and *V. greggii* (83). The two intermediate populations (85, 86) were collected along a road cut through the Santa Rosa Canyon connecting the ranges of *V. ervendbergii* and *V. greggii*. Scatter diagrams of *V. greggii*, *V. ervendbergii*, and putative hybrid populations confirm that natural hybridization does occur between the Mexican taxa (Fig. 5). Most of the individuals in the hybrid population appeared to be F_1 hybrids rather than backcrosses to either parent.

Vernonia schaffneri populations generally are intermediate between *V. ervendbergii* and *V. greggii* and resemble closely the population (86) discussed above. This possibly could be the result of past hybridizations, with the hybrids now occupying slightly different habitats than either *V. ervendbergii* or *V. greggii*.

Transplant studies and ecology. In the autumn of 1970 and the summer of 1971, rootstocks of *Vernonia ervendbergii*, *V. greggii*, and *V. schaffneri* were collected from the field, potted, and grown in the greenhouse and transplanted into the Botany Plant Growth Facility Garden in Athens in the spring of 1971 and 1972. Rootstocks of *V. texana* were collected in the summer of 1971 and transplanted to the garden in the spring of 1972.

Transplants of *Vernonia ervendbergii*, *V. greggii*, and *V. schaffneri* from Mexico, and *V. texana* from the south central United States became established and were successfully over-wintered for four years at Athens until termination of the experiment. Vegetative shoots began emerging from the underground rhizomes during late April and early May. Floral development in the three Mexican taxa began in late May with some anthesis by the first week in June and by mid-June they were at the peak of flowering. The flowering period normally lasted for 3–4 weeks. *Vernonia texana* began growing vegetatively about the same time as the Mexican taxa but did not reach peak flowering until the middle of August. The garden populations of *V. texana* showed a variation of 7–10 days in the time of anthesis, with the populations from Arkansas flowering before those from southeast Texas.

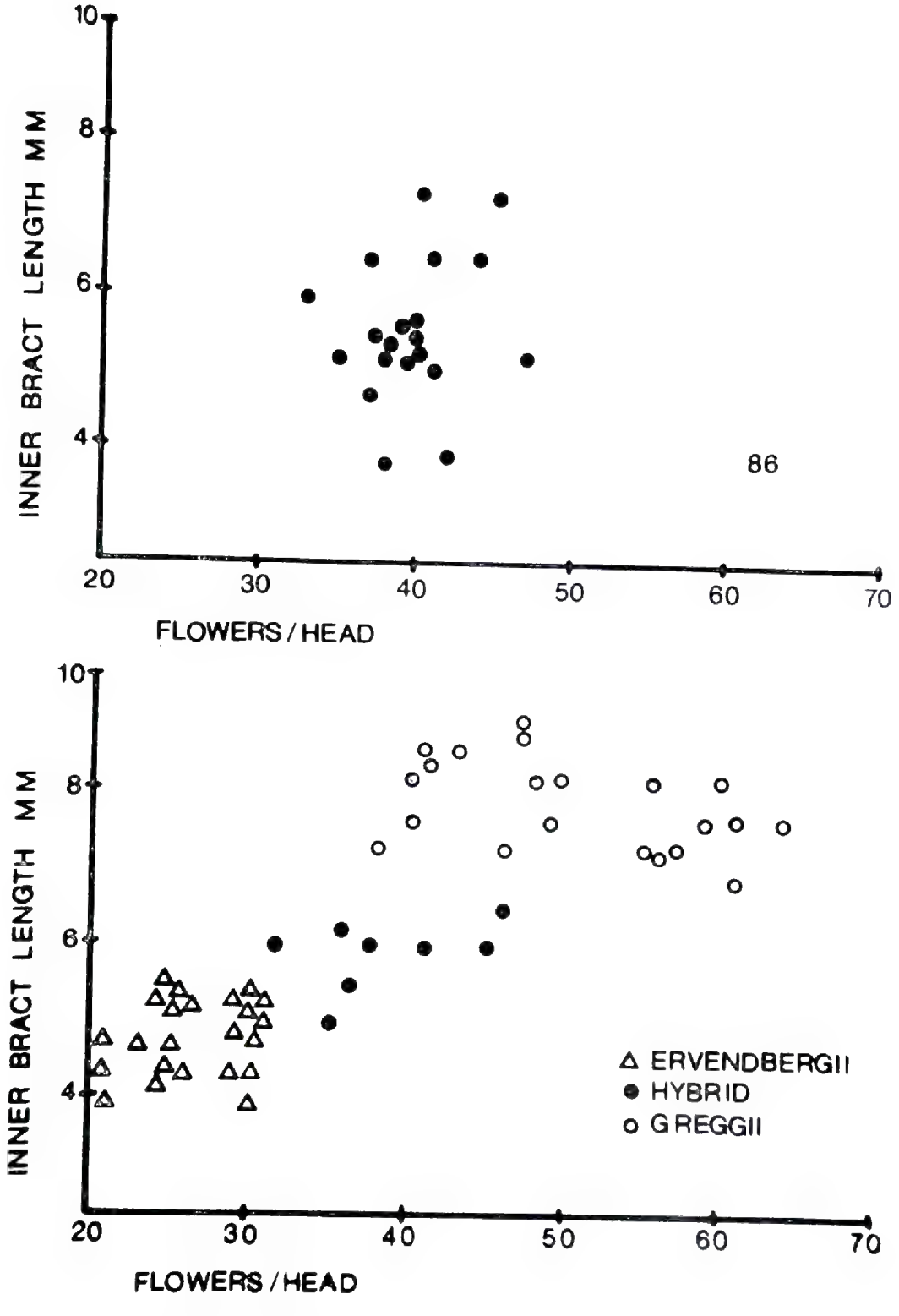

Fig. 5. Scatter diagrams of hybridization between *Vernonia greggii* and *V. ervendbergii*. Local population sample *86* (top) is a hybrid population which includes primarily hybrid type plants. The lower diagram compares typical *V. greggii* (83), artificial F_1 *V. greggii* X *V. ervendbergii* hybrids (X35C), and typical *V. ervendbergii* (87).

The Mexican taxa are found primarily in the open oak-pine vegetative zone at ca. 4500 ft to 7500 ft in the Sierra Madre Oriental on limestone parent material. They also invade semi-disturbed habitats such as roadsides or pastures and sometimes form large local populations. The soils from habitats of *Vernonia ervendbergii* and *V. greggii* are of similar pH and type. There are many exposed limestone boulders in these areas, and the soil is very dark colored with a pH of 7–8. *Vernonia ervendbergii* occupies the moist, slightly alkaline soils in the open oak-pine zone of the eastern slopes of the Sierra Madre Oriental. *Vernonia greggii* is found on the western side of the Sierras in slightly alkaline soil of the open pine zone where, due to the rain shadow, there is less moisture. *Vernonia schaffneri*, found in the extreme southern part of the species-group's range in Mexico, inhabitats severely eroded, over-grazed pastures. Much more precipitation falls in this area, as evidenced by the lush vegetation and severely eroded pastures. Some parental limestone rocks are exposed, but the soil is not as well-drained as that of *V. ervendbergii* or *V. greggii*. This soil is red with a pH of 4–5.

Vernonia texana is associated with the pine-oak communities of east Texas to Mississippi, north to the mixed hardwood forest of central Arkansas. These habitats are typically dry, on sandy soil with little organic matter and a pH of approximately 5.5. Plants of *V. texana* are widely scattered in openly grazed areas, woodlands, and along road and railroad right-of-ways.

SYSTEMATICS AND TAXONOMIC TREATMENT

Vernonia texana is uniform throughout its range in chromosome number and leaf anatomy. It is variable in a few morphological characters (leaf width and leaf length/width); however, no sharp discontinuities were detected in the morphological variation. Interspecific hybridization also causes some local morphological and flavonoid variation. The transplant studies indicated a slight variation in the phenology of local populations on a north-south gradient. Although variation was noted within *V. texana*, no distinct subpopulations that merit naming were detected.

The three Mexican taxa, *Vernonia ervendbergii, V. greggii*, and *V. schaffneri*, are more closely related to each other than to *V. texana*. Cytologically and phytochemically, the three Mexican taxa are identical as all have the sesquiterpene lactone glaucolide-A and the same flavonoid compounds (Mabry, *et al.*, 1975). Also, the leaf venation, trichome complement, and internal leaf anatomy are similar; nevertheless, slight variation in the leaf epidermal pattern exists among the taxa. The vegetation zone where all three taxa grow in the Sierra Madre Oriental is similar (Leopold, 1950), although their micro-habitats differ. With the exception of one character, the number of flowers per head, the three taxa are not easily distinguished from one another. The values obtained for almost all morphological characters overlapped, including the number of flowers per head. The MUDAID-6400 (discriminant analysis) program did not provide any combination of

characters that clearly separated one taxon from another. There was, however, a rather distinct geographical correlation with the morphological variation.

The four taxa in the Texanae species-group are closely related. The phytochemical data, both flavonoid and sesquiterpene, was identical. There were no differences in the chromosome number or basic leaf anatomy since the same kinds of trichomes, leaf venation, and leaf epidermal patterns were found in all members of the group. A discriminant analysis of morphological characters from local population samples throughout the range of each taxon suggested that *Vernonia texana* is separable from the three Mexican taxa. In contrast, the three Mexican taxa were not distinctly separable from each other. Artificial hybridization experiments indicated that no gross chromosomal differences existed among the four taxa. Fertility was high among the F_1s, and no hybrid breakdown was found within the group. Although the habitats and geographical ranges are diverse, all taxa were able to survive for four years in a uniform garden in the Piedmont of the Southeastern United States. However, as Miranda and Sharp (1950) first suggested, the climates of the uplands of the southeastern United States and of the Sierra Madre Oriental of northeastern Mexico are surprisingly similar.

The four taxa were probably derived from a common ancestral line. *Vernonia texana* should be maintained as a species and the three Mexican taxa treated as subspecies. Since *V. ervendbergii*, *V. greggi*, and *V. schaffneri* were described by Asa Gray (1882) in the same publication, the choice of which name to apply is entirely a matter of preference for the author (Stafleu, 1972) and *V. greggii* was selected.

During the course of this study a herbarium specimen from Mexico was discovered which could not be assigned to the Mexican subspecies. The specimen's collection location (Muzquiz, Coahuila) is most interesting, since this site is directly along the likely migration route that *Vernonia* used to reach the United States (Jones, 1976). We feel that this most likely represents a different population and should, therefore, be treated as a subspecies of *V. greggii*. Ideally, a systematist should have more material on which to describe a subspecies; however, at this time this is impossible. A trip to Muzquiz was made in August 1973 to search for additional plant material of this taxon but the trip was unsuccessful due to the remoteness of the area and mechanical troubles with the vehicle.

1. Heads 11–35 flowered (usually ca. 20); middle cauline leaves 0.2–3.4 cm wide, stiff; involucres 4–9 mm high; pinelands, E Texas, SE Okla., Ark., La., SW Miss. . . . . 1. *V. texana*.
1. Heads 15–75 flowered (usually over 27); middle cauline leaves 0.7–5 cm wide, flexible; involucres 5–15 mm high; oak-pine zone, Sierra Madre Oriental . . . . . 2. *V. greggii*.

1. VERNONIA TEXANA (Gray) Small, Fl. S. E. U. S. 1160. 1903.
Vernonia angustifolia Michx. var. *texana* Gray, Syn. Fl. N. Am. 1: 91. 1884. TYPE: Louisiana, *Dr. Hale s.n.* (HOLOTYPE: NY!)
Vernonia angustifolia T. & G. Fl. N. Am. 2: 59. 1841. TYPE: Louisiana, *Dr. Hale s.n.* (HOLOTYPE: NY!)

Vernonia granienifolia [sic] Walt. var. *texana* (Gray) Trel. ex Branner & Coville, Rep. Geol. Surv. Ark. for 1888. 189. 1891.
Cacalia angustifolia (Michx.) Kuntze var. *texana* Gray, Rev. Gen. Pl. 232. 1891.

Perennial herbs; stems erect, puberulent to glabrate, 4–10 dm high; leaves scattered, cauline; blades of middle stem leaves 0.2–1.4 cm wide, 6.5–13.5 cm long, linear to linear-lanceolate or sometimes lanceolate, scabrous above, scabrous to puberulent beneath, apically acute, basally attentuate, margins revolute, remotely serrate, or sometimes prominently toothed; petioles 1–4 mm long, puberulent; inflorescence loose and open; heads 15–25 flowered; involucre broadly campanulate, 4–6 mm high, 5–7 mm wide; phyllaries imbricate, slightly appressed, greenish-purple, ciliate; inner phyllaries oblong to oblong-lanceolate, 2.9–6 mm long, 1–1.7 mm wide with acute to short-acuminate tips ca. 0.1–0.2 mm long; pappus brownish to straw colored, often tinged with purple, inner bristles 5.5–7 mm long; outer scales ca. 0.6 mm long; corollas 9–11 mm long; achenes 1.5–3 mm long; flowering from late July to August; chromosome number $n = 17$.

This species is distributed from Arkansas and SE Oklahoma south to E Texas and SW Mississippi (Fig. 1).

Vernonia texana grows in well-drained soil of pinewoods and along roadsides. This species is known to hybridize in nature with *V. baldwinii*, *V. gigantea* and *V. missurica*.

2. VERNONIA GREGGII Gray, Proc. Am. Acad. 17: 204. 1882. Typification listed under subspecies.

Perennial herbs; stems erect, puberulent to glabrate, 2–10 dm high; leaves scattered, cauline; blades of middle stem leaf 0.7–5 cm wide, 3.3–12.5 cm long, lanceolate to linear-lanceolate, elliptic or ovate, scabrous above, scabrous to puberulent beneath, apically acute to acuminate, or obtuse, basally narrowed to nearly sessile, margins serrulate to remotely serrulate; petioles 1–3 mm, nearly sessile, puberulent; inflorescence loose and open, sometimes flattened; heads 14–75 flowered; involucre campanulate to hemispheric, 5–15 mm high, 4–18 mm wide; phyllaries imbricate and appressed, with acute to obtuse or long acuminate tips, glabrous to thinly ciliate; achenes 3.5–10 mm long; flowering from early June to late July; chromosome number $n = 17$.

This species is distributed throughout the Sierra Madre Oriental of Mexico (Fig. 1). The subspecies are characterized by the following key:

1. Heads ca. 75 flowered; outer phyllaries long acuminate. . . . . 2d. ssp. *faustiana*.
1. Heads less than 70 flowered; outer phyllaries not long acuminate.
   2. Middle stem leaves lanceolate to linear-lanceolate, heads usually over 40 flowered; western slopes of Sierra Madre Oriental. . . . . 2a. ssp. *greggii*.
   2. Middle stem leaves elliptic to ovate, heads usually less than 40 flowered; eastern slope of the Sierra Madre Oriental.
      3. Heads 27 (14–36) flowered, phyllaries greenish with purple tips, pappus whitish to straw colored. . . . . .2b. ssp. *ervendbergii*.

Heads 36 (21–50) flowered, phyllaries purple, pappus brownish-tawny colored. . . . . 2c. ssp. *schaffneri*.

2a. VERNONIA GREGGII Gray ssp. GREGGII

TYPE: Mexico: Nuevo Leon, valley near Saltillo, 1848, *Gregg 102* (HOLOTYPE: MO!)

Vernonia greggii Gray var. *palmeri* Gray, Proc. Am. Acad. 17: 204. 1882. TYPE: Mexico: Nuevo Leon, 1880, *Palmer 753* (HOLOTYPE: NY!)

Vernonia taylorae Standl., Field Museum Pub. Botan. 17: 224. 1937. TYPE: Mexico: Hacienda Pabillo, Galeana, Nuevo Leon, 1963, *Taylor 9* (HOLOTYPE: F!, ISOTYPE: TEX!)

Vernonia greggii ssp. *greggii* is distributed through the drier western side of the Sierra Madre Oriental from about Dr. Arroyo, Nuevo Leon, to the mountains immediately west of Monclova, Coahuila. This subspecies grows in rocky limestone soil, along roadsides in full sun, but is often found in semi-shade under sparse oak-pine-juniper forest. Sometimes robust plants are found along wet ditches or dry stream sides. This taxon is somewhat variable throughout its geographical range. The range of this taxon overlaps with the range of *V. greggii* ssp. *ervendbergii* in the Santa Rosa Canyon east of Galeana, Nuevo Leon, and hybridization has been documented from populations in this area.

2b. VERNONIA GREGGII Gray ssp. **ervendbergii** (Gray) Chapman and Jones stat. nov.

Vernonia ervendbergii Gray, Proc. Am. Acad. 17: 203. 1882. TYPE: Mexico: 25 mi SW Monclova, Coah., 1880, *Palmer 750* (SYNTYPES: GH! NY!)

Vernonia greggii ssp. *ervendbergii* grows in the oak-pine vegetation along the eastern escarpments of the Sierra Madre Oriental. Its range extends from about Monterrey, Nuevo Leon, southward to immediately north of Xilitla, S.L.P. It is also found to the east on the outlying Sierra de Tamaulipas in the Coastal Plain of Mexico. This subspecies invades semi-disturbed areas such as roadsides and cut-over forests. The soil in which it grows is black, moist, and slightly alkaline.

2c. VERNONIA GREGGII Gray ssp. **schaffneri** (Gray) Chapman and Jones stat. nov.

Vernonia schaffneri Gray, Proc. Am. Acad. 17: 204. 1882. TYPE: Mexico: near San Luis Potosi, S.L.P., 1877, *Schaffner 347* (SYNTYPES: NY!, GH!, US!)

Vernonia greggii ssp. *schaffneri* has the most restricted range of the three subspecies. This taxon is found only in the vicinity of Jacala, Hidalgo, SW of Xilitla, S.L.P., Hidalgo in the state of Queretaro, and the vicinity of Las Rusias east of San Luis Potosi, S.L.P. This subspecies seems to be associated with grazed-over pastures that are eroded into gullies. The soil is acidic, red, and gummy.

Although natural hybridization between *V. greggii* ssp. *schaffneri* and ssp. *ervendbergii* was not documented in this study, it is speculated that there may be gene flow via the mountains W of Xilitla, S.L.P. to San Luis Potosi, S.L.P. Unfortunately no roads traverse this area.

2d. VERNONIA GREGGII Gray ssp. **faustiana** Chapman and Jones ssp. nov.

TYPE: Mexico: Canyon in Sierra Hermosa de Santa Rosa, 25 mi NW Melchor Muzquiz, Coahuila, 1963, *Latorre 13* (HOLOTYPE: TEX!)

Herbe perennes erectae, 0.3–0.6 metralis, caulibus tomentosis; folia 9–13 cm longa, 1.5–2.5 cm lata, linearis-lanceolatus; scaberalus supra et infra, apicibus acutis, basibus cuneatis, marginibus dentatis, petioli 2–4 mm longi; inflorescentiae dense compactis; capitula ca. 75 florata; involucra campaniformis-hemisphericae, 9–10 mm longa, 11–15 mm lata; phyllaria imbricata, appresus, stramineo-purpurea; phyllaris interioribus linearis, 8–9 mm longis, 1.0–1.3 mm latis; phyllaris externis acumnatis longis, apicem-purpurea, 1–2 mm longis; pappi stramineus; setae interiores 7–8 mm longis; setae externae ca. 1.0 mm longis; corolla purpurea, 10–11 mm longis; achaenia fere glabris, 4–8 mm longis.

This subspecies is named in honor of Dr. W. Z. Faust, who was properly introduced to Mexico during the unsuccessful search for additional material of this taxon.

APPENDIX
COLLECTION LOCATIONS FOR SAMPLES OF *VERNONIA*

Voucher specimens (deposited in GA) of materials used in the study of flavonoids (annotated *f*), cytology (*c*), hybridization (*h*), and morphology (*m*). Collection numbers are those of the senior author unless otherwise noted.

Vernonia greggii ssp. *greggii*

MEXICO: NUEVO LEON: 2.1 mi S Pabillo, *51* (*c,f,h*); 29 mi N Dr. Arroyo, *80* (*c,f,h,m*); 30 mi N Dr. Arroyo, *81* (*c,m*); ca. 40 mi N Dr. Arroyo at LaJoya, *82* (*c,f,m*); 18 mi S Galeana, *83* (*c,m*); 9 mi E Galeana, *85* (*m*); 14 mi E Galeana, *86* (*m*).

Vernonia greggii ssp. *ervendbergii*

MEXICO: NUEVO LEON: Horsetail Falls, *45* (*c,f,h*); Horsetail Falls, *87* (*c,f,h,m*).—QUERETARO: 15 mi S Jalpan, *71* (*c,m*). Km 226, hwy. 120, 15 mi N Landade Matamoros, *72* (*m*).—SAN LUIS POTOSI: 20 mi W Valles, *75* (*c,m*); Km 71, 42 mi W Valles, *76* (*c,m*).—TAMAULIPAS: Km 153, hwy. 101, Victoria, *46* (*c,f,h*); km 153, hwy. 101, Victoria, *60* (*m*).

Vernonia greggii ssp. *schaffneri*

MEXICO: HIDALGO: 5 mi S Jacala, *49* (*c,f,h*); Km 111, hwy. 85, Puerto La Zorra, *66* (*c,f,m*); 10 mi S. Jacala, *68* (*c,m*); 17 mi S Jacala, *69* (*m*).—SAN LUIS POTOSI: Km 233, hwy. 120, 20 mi S Xilita, *73* (*c,m*); ca. 31 mi E San Luis Potosi, at Las Rusias, *79* (*c*).

Vernonia texana

UNITED STATES: ARKANSAS: ASHLEY CO.: 10 mi W Parkdale, *91* (*c,f,m*); 20 mi W Parkdale, *92* (*f,m*). CLEVELAND CO.: 8 mi N New Edinburg, *94* (*m*). DALLAS CO.: 1 mi S Princeton, *96* (*f,m*). HOT SPRING CO.: near DeRoche, *97* (*f,m*); 3 mi E Bismarck, *98* (*f,m*); ca. 9 mi NW Malvern, *Jones 15839* (*c,f,h,m*); ca. 9 mi MW Malvern, *Jones 15840* (*f*); ca. 9 mi NW Malvern, *Jones 15842* (*f,m*); ca. 9 mi NW Malvern, *Jones 15843* (*f,m*). *POLK CO.*: 5 mi N Grannis, *99* (*f,m*); 2 mi N Grannis *100* (*f,m*).—LOUISIANA: VERNON Pa.: 3 mi N Slagle, *56* (*c*); 5 mi N Leesville, *Jones 17658* (*f,h,m*).

—MISSISSIPPI: AMITE CO.: 1.3 mi E Lincoln—Amite Co. line, *Jones 2293* (*m*). FRANKLIN CO.: Clear Springs Lake, *Jones 2292* (*c,h,f,m*). PIKE CO.: 4 mi N Magnolia, *Jones 19645* (*c,h,m,f*).—TEXAS: CHEROKEE CO.: 2 mi N Jacksonville, *104* (*f,m*); 8 mi N Jacksonville, *105* (*c,m*). COLORADO CO.: 7 mi W Columbus, *90* (*c,f*). GOLIAD CO.: 10 mi SW Victoria, *59* (*c,f,m*). JASPER CO.: 6 mi NE Burkeville, *Jones 17659* (*c,f,h,m*). LEON CO.: 1 mi N Buffalo, *106* (*f,m*). MILAN CO.: 13 mi N Rockdale, *107* (*c,f,m*). RUSK CO.: 4 mi NW Tatum, *102* (*f,m*); 12 mi SW Tatum, *103* (*f,m*). TYLER CO.: 5 mi W of Woodville, *Jones 17661* (*f,m*).

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MISSISSIPPI FLORA: A GUIDE TO THE FERNS AND FERN ALLIES

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ABSTRACT

Keys, distribution maps, habitats, nomenclature, and notes are given for the ferns and fern allies known to occur naturally or naturalized in Mississippi.

INTRODUCTION

This paper represents my contribution to the Flora of Mississippi Project, an effort being undertaken primarily by Drs. Sam Jones, (University of Georgia), Tom Pullen, (University of Mississippi), and Ray Watson (Mississippi State University). Hopefully, this information will stimulate efforts to improve knowledge of the ferns and fern allies of the state, so that any additions or corrections can be incorporated before the proposed comprehensive guide to the flora of Mississippi is published. Any overlooked species, additional collections, needed modifications, or suggestions are welcomed so that appropriate revisions can be made.

The primary sources of information for this treatment are the herbarium collections of the University of Mississippi, Mississippi State University, and the University of Southern Mississippi, and only those taxa supported by voucher materials or unquestionably substantiated in the literature are included. References made to some of the standard manuals of the southeastern flora are abbreviated as follows: Small, 1938 (S); Fernald, 1950 (F); Gleason and Cronquist, 1963 (G); Evans, in Radford et al., 1968 (R). Other taxonomic works used in preparation of this treatment are cited in the text.

The physiographic regions of Mississippi, based on those of Lowe (1921) are outlined in Fig. 1. The abbreviations used in the text are: Tennessee River Hills (TRH); Northeastern Pine Belt (NPB); Pontotoc Ridge (PR); Flatwoods (FW); North Central Plateau (NCP); Jackson Prairie (JP); Loess Bluff Hills (LBH); Yazoo-Mississippi Delta (YMD); Longleaf Pine Region (LPR); and Coastal Pine Meadows (CPM).

PTERIDOPHYTA

1. Plant free-floating on water or resting on mud; spores of 2 sizes, megaspores and microspores . . . . . 13. Azollaceae.
1. Plants rooted to soil or mud; spores of one or two sizes.
   2. Plant conspicuously jointed; the leaves fused together at least basally

[1] Contr. Bot. Lab., Univ. Tenn., N.S. 497.

SIDA 7(3): 282–297. 1978.

into sheaths; sporangia borne below peltate plates in terminal cones. . . . . 1. Equisetaceae.

2. Plant not jointed; the leaves all separate and not forming sheaths; sporangia borne variously but not on peltate plates.
   3. Sporangia in axils of scale-leaves or buried in basal pockets of soft tubular rush-like leaves; leaves with only a single vein or midrib, or none.
      4. Plant tufted, rush-like, the stem forming a lobed corm; leaves 5–50 cm long; spores of two sizes . . . . . 4. Isoetaceae.
      4. Plant like coarse moss; the stems elongate and branching; leaves 0.1–1.5 cm long.
         5. Plant robust, usually 8–40 cm tall; the shoots usually 5–20 mm broad; spores of one size . . . . . 2. Lycopodiaceae.
         5. Plant slender, usually low, rarely more than 5 cm tall; shoots usually 2–6 mm broad; spores of 2 sizes . . 3. Selaginellaceae.
   3. Sporangia on long, simple or branching "fertile spikes" arising from the leaf, or borne upon surfaces of normal or contracted leaf blades; leaves simple or divided, with lateral veins arising from the midribs.
      6. Sporangia 0.5–1 mm broad, exposed on panicle-like cluster or sunken in spike-like projections from the blade base or petiole base but not on separate modified non-green leaf. . 5. Ophioglossaceae.
      6. Sporangia 0.1–0.4 mm broad, borne directly upon leaf blade or on non-green skeletonized leaf or leaf apex (Osmundaceae), or inrolled bead-like leaflets ca. 2–4 mm in diam. of specialized non-green leaf in *Onoclea* (Aspleniaceae).
         7. Leaves specialized into "vine-like" organs which climb upon other vegetation; sporangial annulus apical . . . 7. Schizaeaceae.
         7. Leaves typically fern-like, not "vine-like"; sporangial annulus lateral, or as a more or less vertical bow.
            8. Bases of leaves with stipules or thin lateral wings; sporangia with only a lateral patch of thickened annular cells. . . . . 6. Osmundaceae.
            8. Bases of leaves lacking stipules; sporangia with a well-defined bow-shaped annulus.
               9. Leaf blade delicate, filmy, only 1 cell thick between the veins; sporangia in outward-facing cup-like or 2-valved involucres at the leaf margin. . . . . 8. Hymenophyllaceae.
               9. Leaf blade thick, at least 2 or more cells thick between veins; sporangia dorsal or marginal, but not in an outward-facing marginal cup.
                  10. Sori marginal, covered by revolute marginal leaf tissue.
                     11. Rhizome and leaf bases clothed with hairs only; sorus continuous along leaf margin, petioles green or stramineous, coarse and tough. . . . . 9. Dennstaedtiaceae.
                     11. Rhizome and leaf bases clothed with scales; sorus continuous along leaf margin, or, if round, the petiole ebony colored and brittle. . . . . 10. Adiantaceae.
                  10. Sori on the underside of the leaf blade, if marginal the indusia kidney-shaped and not continuous with the leaf margin.
                     12. Sorus round, or linear along the veins; indusium present or, if lacking, the leaf pinnate or more dissected. . . . . 11. Aspleniaceae.
                     12. Sorus round; indusium lacking; leaf 1-pinnatifid. . . . . 12. Polypodiaceae.

1. EQUISETACEAE

EQUISETUM L. Scouring-Rush

1. *E. hyemale* var. *affine* (Engelm.) A. A. Eat. May-Aug. Railroads, roadsides, stream banks; LBH, NCP, YMD. *E. praealtum* Raf.—S. Fig. 1.

2. LYCOPODIACEAE

LYCOPODIUM L. Clubmoss

1. Upright shoot diffusely branched; strobili nodding. . . 1. *L. cernuum.*
1. Upright shoot unbranched or few-branched, terminating with 1-few erect strobili.
   2. Leaves of the fertile upright shoot sharply differentiated between peduncle and strobilus; leaves of the peduncle not imbricated; horizontal stems strongly dorsiventral. . . . . 2. *L. carolinianum.*
   2. Leaves of the fertile upright shoots with similar sporophylls and vegetative leaves; leaves of the peduncle densely imbricate; horizontal stems only slightly dorsiventral. (Hybrids with intermediate morphology are typically encountered between the following three taxa when in mixed populations.)
      3. Upright shoots (including leaves) 4 mm or less in diam.; leaves of the peduncle and strobilus appressed and entire, or rarely with a few cilia at the leaf base; horizontal stems somewhat dorsiventral and rooting to the ground throughout. . . . . 3. *L. appressum.*
      3. Upright shoots (including leaves) 6 mm or more in diam.; leaves of peduncle ascending and incurved and those of the strobilus spreading, leaves ciliate throughout; horizontal stems not, or only slightly, dorsiventral either flat and rooting continuously or arching and rooting intermittently.
         4. Horizontal stems rooting continuously along the ground, the rhizome (less leaves) 2 mm or less in diam., the leaves usually spreading almost at right angles to the rhizome; growth of the current year usually with only one (occasionally 2) erect fertile shoots, and usually without additional stiffly erect but sterile shoots. . . . . 4. *L. prostratum.*
         4. Horizontal stems strongly arching and rooting only intermittently, the rhizome 3 mm or more in diam., the leaves usually ascending and/or incurved; growth of the current year usually with 2 or more (occasionally only one) erect fertile shoots, and usually with 1-several additional stiffly erect sterile shoots. . 5. *L. alopecuroides.*

1. *L. cernuum* L., Nodding C. All year. Wet loamy roadbanks; George and Jackson Cos. Fig. 1.

2. *L. carolinianum* L., Slender C. Jul-Nov. Wet bogs, sandy meadows, pinelands, and roadsides; CPM, LPR, and NCP. Fig. 1.

3. *L. appressum* (Chapm.) Lloyd & Underw., Southern Bog C. Jul-Nov. Bogs, wet meadows, pinelands, roadsides, and lake shores; CPM, LPR, NCP, and TRH. *L. inundatum* var. *bigelovii* Tuckerm.—F, G. Hybridizes frequently with nos. 4 and 5. Fig. 1.

4. *L. prostratum* Harper, Prostrate Foxtail C. Jul-Nov. Bogs, wet roadsides, lake shores, savannahs and pinelands; CPM, LPR, and NCP. *L. alopecuroides* L.—F, G, R, in part. Hybridizes frequently with nos. 3 and 5. Fig. 1.

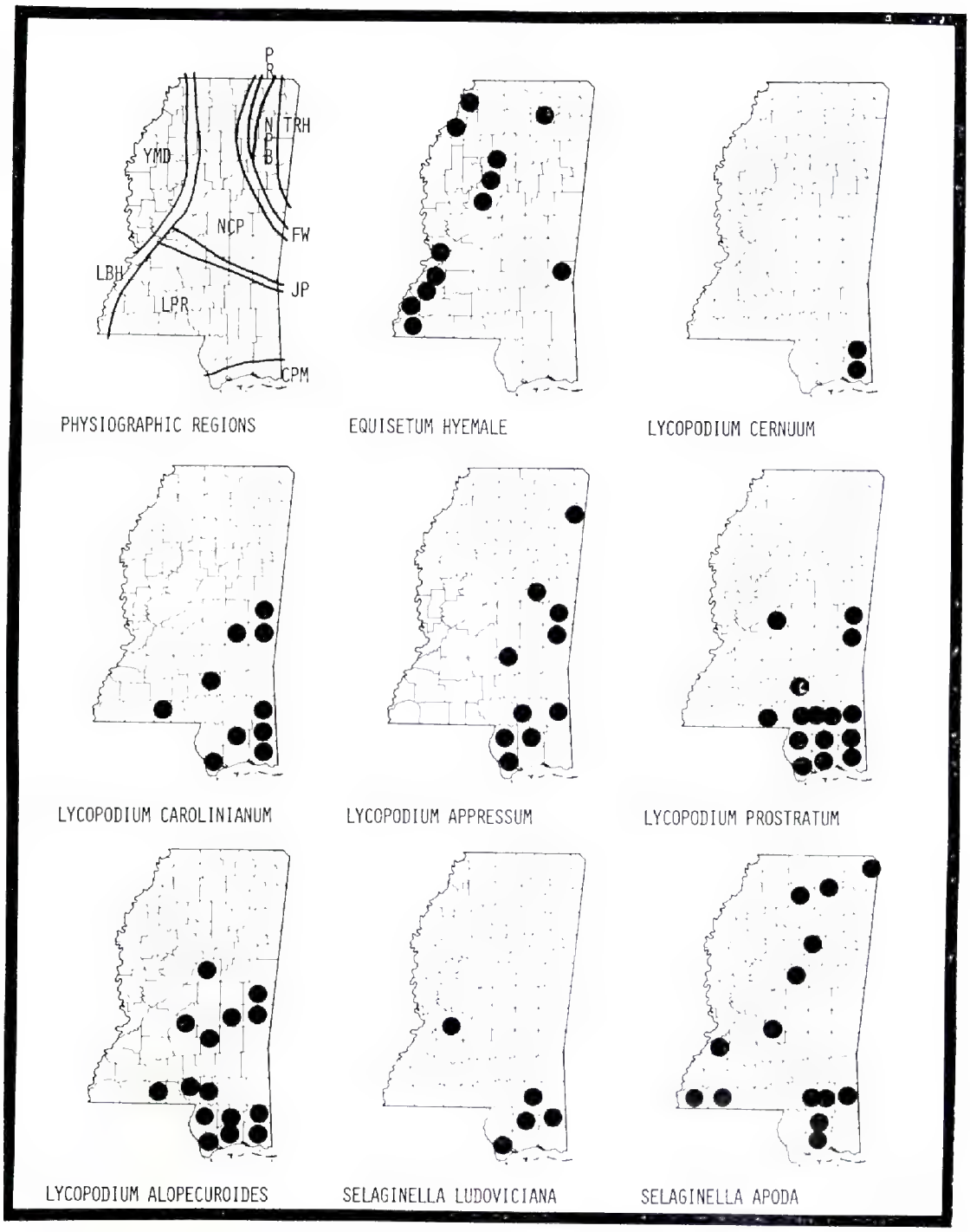

Figure 1. Physiographic regions of Mississippi (see text) and distribution in Mississippi of *Equisetum hyemale* var. *affine*, *Lycopodium cernuum*, *L. carolinianum*, *L. appressum*, *L. prostratum*, *L. alopecuroides*, *Selaginella ludoviciana*, *S. apoda*.

5. *L. alopecuroides* L., Foxtail C. Jul-Nov. Bogs, wet roadsides, lake shores, savannahs, and pinelands; CPM, JP, LPR, and NCP. Hybridizes frequently with nos. 3 and 4. Fig. 1.

Species nos. 3, 4, and 5 represent a confusing complex of taxa which are presently under investigation. Intermediates which we interpret to be hybrids are encountered when two or more grow in proximity; pure stands appear uniformly to conform to the species standards outlined here (with J. C. Odenwelder, *pers. com.*).

3. SELAGINELLACEAE

SELAGINELLA Beauv. Spikemoss

1. Leaf blades with wide hyaline margins with 2-4 rows of elongate hyaline cells; strobilus 10–20 mm long; plant mostly ascending. 1. *S. ludoviciana.*
1. Leaf blades with narrow hyaline margins with 0-1 row of elongate hyaline cells; strobilus 6–15 mm long; plant mostly creeping. . . 2. *S. apoda.*

1. *S. ludoviciana* A. Br., Louisiana S. Jun-Oct. Moist deciduous and pine woods; CPM and LPR. *Diplostachyum ludovicianum* (A. Br.) Small—S. Fig. 1.

2. *S. apoda* (L.) Spring., Meadow. S. Jun-Oct. Wet roadsides, deciduous woods, bogs, and stream banks; CPM, LPR, NCP, and TRH. *Diplostachyum apodum* (L.) Beauv.—S; S. *apoda* (L.) Fern.—F. Fig. 1.

This treatment follows that of Somers and Buck (1975).

4. ISOETACEAE

ISOETES L. Quillwort

1. *I. engelmannii* A. Br., Engelmann's Q. Apr-Nov. Small pond margin; Tishomingo Co. First collected for the state in 1975. Fig. 6.

5. OPHIOGLOSSACEAE

1. Sterile segment of leaf dissected; fertile spike branched. 1. *Botrychium.*
1. Sterile segment of leaf simple; fertile spike simple. . 2. *Ophioglossum.*

1. BOTRYCHIUM Sw. Grapefern

1. Leaves herbaceous, or coriaceous; leaves and spores maturing in late winter or spring; fertile segment separating from the petiole 0.5 cm or less below sterile pinnae.
   2. Leaves herbaceous, 8–80 cm high, sterile blade raised well above the ground. . . . . .1. *B. virginianum.*
   2. Leaves coriaceous, 6–14 cm high, sterile blade lying close to the ground. . . . . 2. *B. lunarioides.*
1. Leaves coriaceous, evergreen or appearing only in late summer or fall; spores maturing in late summer or fall; fertile segment joining petiole more than 0.5 cm below sterile pinnae.
   3. Ultimate segments with central veins poorly developed or absent; leaves often two or more per season. . . . . 2. *B. alabamense.*
   3. Ultimate segments with conspicuous central veins; leaves normally one per year.
      4. Blades mostly tripinnate, the outline of the small lateral lobes of

pinnae, or pinnules of more dissected pinnae, rhomboidal and angular, or whole sterile portion highly dissected. . . 3. *B. dissectum.*

4. Blades mostly bipinnate, the outline of the small lateral lobes of pinnae, or pinnules of the more dissected pinnae, oblong and somewhat rounded. . . . . 4. *B. biternatum.*

1. *B. virginianum* (L.) Sw., Rattlesnake-fern. Mar-June. Rich deciduous woods, swamps, ravines, and upland woods; throughout except CPM. Fig. 2.

2. *B. lunarioides* Sw., Prostrate G. Mar-May. Disturbed grassy areas, cemeteries; Clark, George, Greene, Jones, Lauderdale, Wayne Cos. *B. biternatum* sensu Small, not Underwood—S. Fig. 2.

3. *B. alabamense* Maxon, Alabama G. Sep-Oct. Old fields, rare; George Co. Fig. 2.

4. *B. dissectum* Spreng., Common G. Sep.-Oct. Deciduous woods; uncommon and usually confused with the following species; Lafayette, Marshall Cos. includes *B. obliquum* Muhl.—S in part; *B. dissectum* var. *obliquum* (Muhl.) Clute—G. Fig. 2.

5. *B. biternatum* (Sav.) Underw., Southern G. Aug-Oct. Moist pine and deciduous woods, and ravines; scattered throughout except CPM and YMD. *B. dissectum* var. *tenuifolium* (Underw.) Farw.—F, G; *B. obliquum* Muhl.—S, in part; not *B. biternatum* sensu Small—S. Fig. 2.

2. OPHIOGLOSSUM L. ADDER'S-TONGUE

1. Leaf blades less than 3.5 cm long, 2 or more per plant; rhizome short cylindric to globose.
   2. Rhizome globose-bulbose, 4–15 mm in diam.; leaf blades 1–3.5 cm long. . . . . 1. *O. crotalophoroides.*
   2. Rhizome short-cylindric, 2–3 mm in diam.; leaf blades 0.5–1.5 cm long. . . . . 2. *O. nudicaule.*
1. Leaf blades more than 3.5 cm long, mostly 1 per plant; rhizome cylindric.
   3. Main veins forming large primary areoles with included smaller veins forming secondary areoles; leaf apex acute to apiculate. . . . . 3. *O. engelmanni.*
   3. Main veins forming areoles not enclosing finer secondary areoles; leaf apex rounded to acute.
      4. Plants clonal with horizontal stolons producing numerous new plants; usually with 4–8 parallel veins passing through base of sterile blade, producing a slender basal midvein. . . . . 4. *O. petiolatum.*
      4. Plants not clonal, without proliferous stolons; usually with 8–20 veins passing through blade base, producing a heavy basal midvein. . . . . 5. *O. vulgatum.*

1. *O. crotalophoroides* Walt., Bulbous A. Mar-Aug. Sandy lawns and cemeteries; LPR, NCP. Frequent but little collected. Fig. 2.

2. *O. nudicaule* L. f., Least A. Mar-Aug. Lawns, pastures and cemeteries; CPM, LPR, NCP. *O. tenerum* Mett.—S. Frequent but little collected. Fig. 2.

3. *O. engelmanni* Prantl, Limestone A. Mar-Aug. Pastures and open woods, on limestone; Chickasaw, Lafayette, Lee and Madison, Oktibbeha, Warren Cos. Fig. 2.

4. *O. petiolatum* Hook., Stalked A. Feb-Aug. Lawns and cemeteries; LPR. Fig. 2.

5. *O. vulgatum* L. var. *pycnostichum* Fern., Southern A. Mar-Aug. Rich woods and grassy areas; Lafayette, Leflore, Marion, Monroe, Tate, Tishomingo, and Wilkinson Cos. Fig. 3.

Many distribution records in the Ophioglossaceae were contributed by Dr. R. Dale Thomas (Pers. Comm.).

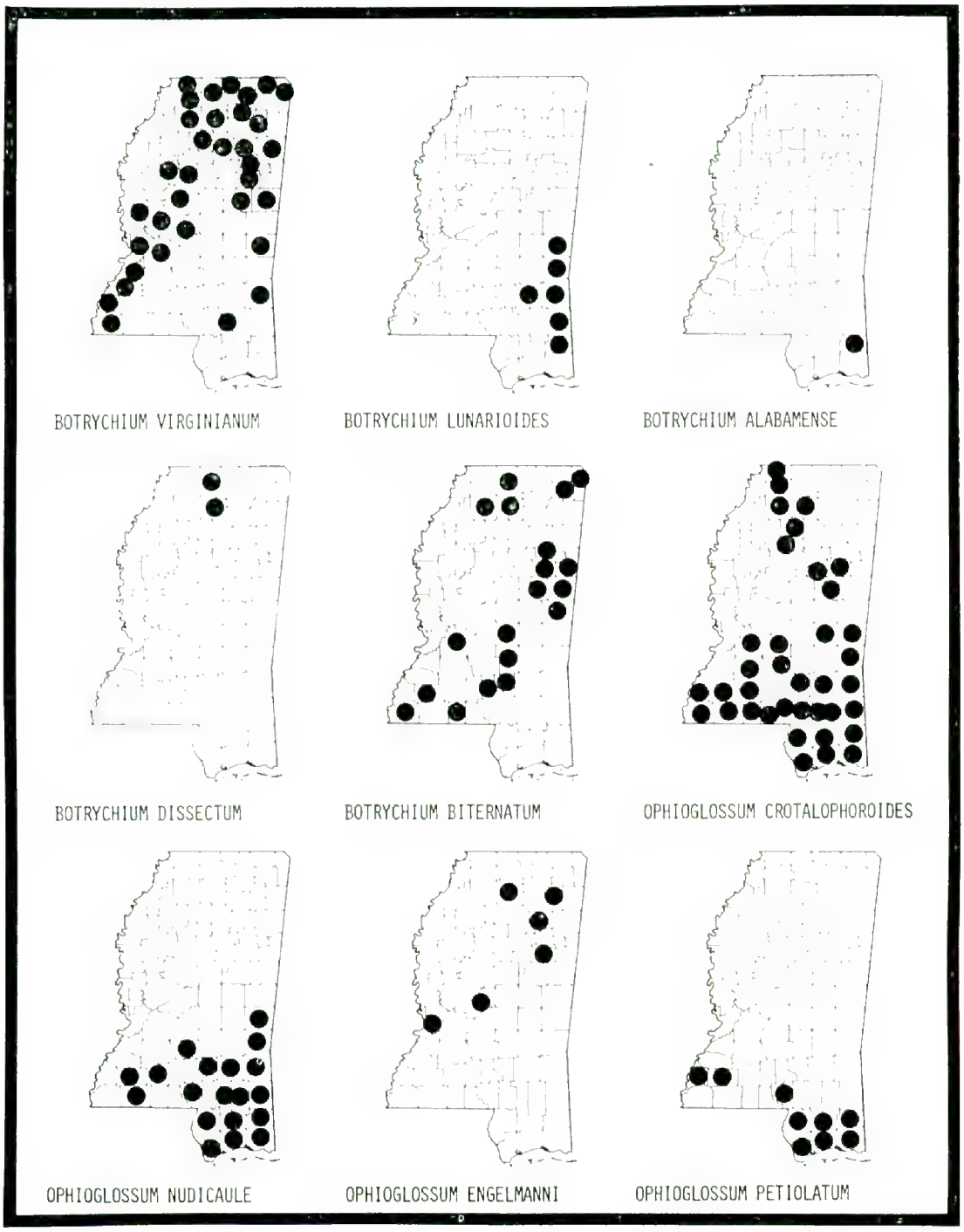

Figure 2. Distribution in Mississippi of *Botrychium virginianum*, *B. lunarioides*, *B. alabamense*, *B. dissectum*, *B. biternatum*, *Ophioglossum crotalophoroides*, *O. nudicaule*, *O. engelmanni*, *O. petiolatum*.

6. OSMUNDACEAE

OSMUNDA L.

1. Leaves 2-pinnatifid, dimorphic, the fertile leaves without lamina. . . . . 1. *O. cinnamomea.*
1. Leaves 2-pinnate, the fertile pinnae confined to the terminal portion of the blade. . . . . 2. *O. regalis.*

1. *O. cinnamomea* L., Cinnamon Fern. Mar-May. Bogs, swamps, pine, and deciduous forests; throughout, except LBH and YMD. Fig. 3.

2. *O. regalis* L. var. *spectabilis* (Willd.) Gray, Royal Fern. Mar-June. Woods, bogs, wet savannahs; throughout, except LBH and YMD. Fig. 3.

7. SCHIZAEACEAE

LYGODIUM Sw. Climbing Fern

1. *L. japonicum* (Thunb.) Swartz, Japanese C. F. May-Nov. Woods and roadsides; chiefly CPM and LPR. Naturalized from Asia. Fig. 3.

8. HYMENOPHYLLACEAE

TRICHOMANES L. Filmy-Fern

1. *T. petersii* Gray, Dwarf Filmy Fern. All year. Wet shaded sandstone, rare; Amite, Simpson, and Smith Cos. Fig. 3.

9. DENNSTAEDTIACEAE

PTERIDIUM Gleditsch Bracken

1. *P. aquilinum* (L.) Kuhn. Jun-Sept. Old fields, open woods and roadsides; throughout, except YMD. *Pteris latiuscula* Desv.—S; *P. caudata* L.—S (in part). Fig. 3.

10. ADIANTACEAE

1. Leaf blades pedate or ovate in outline; sori and indusioid leaflet margin discontinuous. . . . . 1. *Adiantum.*
1. Leaf blades ovate or lanceolate in outline; leaflet margin reflexed producing continuous indusioid margin.
   2. Leaves villose, ultimate segments usually 1–4 mm long. 2. *Cheilanthes.*
   2. Leaves glabrous, ultimate segments usually 8 mm or more long. . . . . 3. *Pteris.*

1. ADIANTUM L.

1. Leaf dichotomous in a fan-like pattern. . . . . 1. *A. pedatum.*
1. Leaf pinnate with a prominent central axis. . . 2. *A. capillus-veneris.*

1. *A. pedatum* L., Maidenhair Fern. Jun-Aug. Rich mesic woods; LBH, NCP, PR, NPB, and TRH. Fig. 3.

2. *A. capillus-veneris* L., Venus'-hair Fern. Jun-Aug. On limestone; Clarke and Wayne Cos. Fig. 3.

2. CHEILANTHES Sw. Lip-Fern

1. *C. lanosa* (Michx.) D.C. Eat., Hairy L. F. Jun-Aug. On sandstone; Lafayette and Tishomingo Cos. Fig. 3.

3. PTERIS L. Brake

1. *Pteris multifida* Poir., Spider B. May-Oct. Rocky woods; Hinds, Jefferson, Warren and Wilkinson Cos. *Pycnodoria multifida* (Poir.) Small—S. Fig. 4.

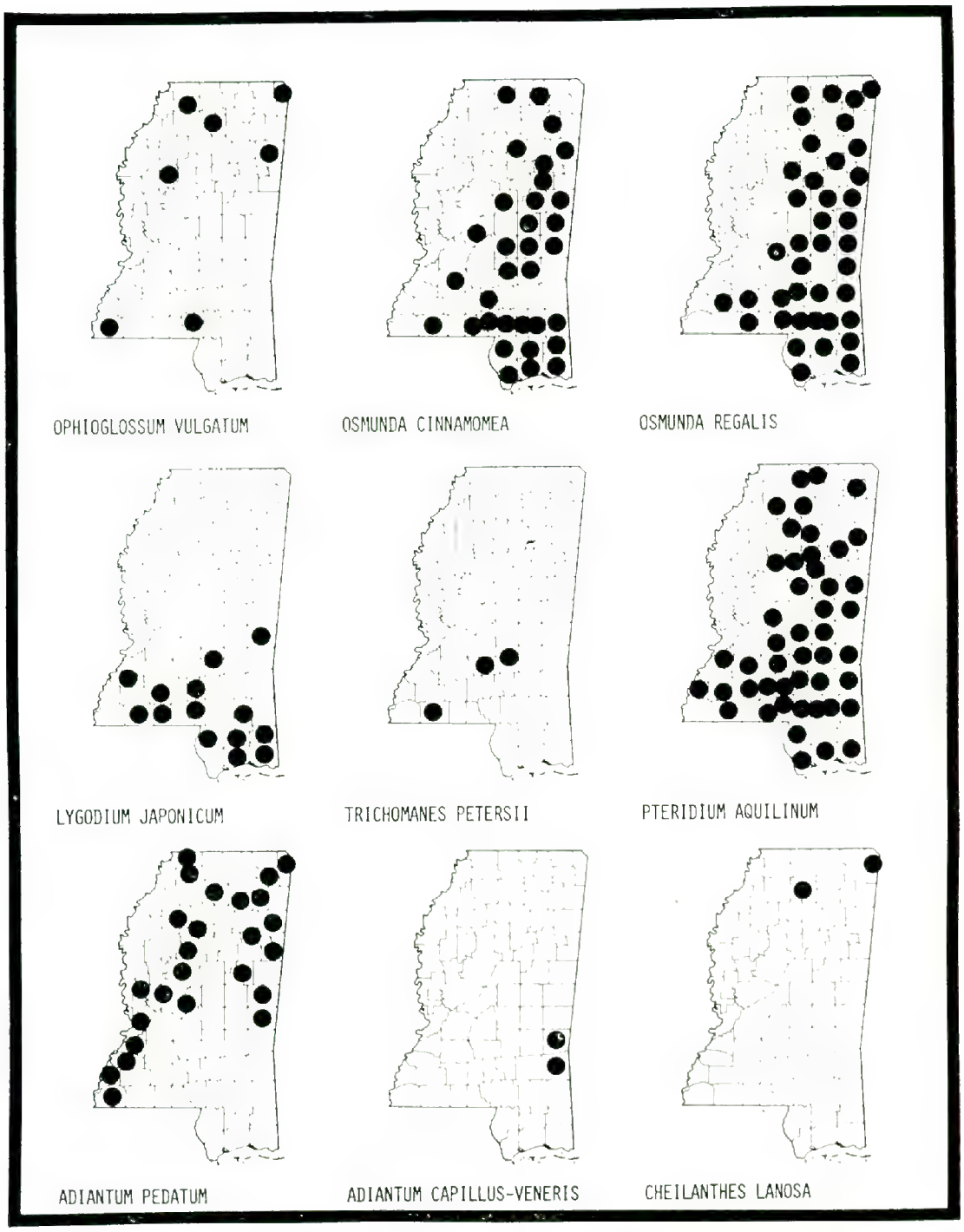

Figure 3. Distribution in Mississippi of *Ophioglossum vulgatum* var. *pycnostichum*, *Osmunda cinnamomea*, *O. regalis* var. *spectabilis*, *Lygodium japonicum*, *Trichomanes petersii*, *Pteridium aquilinum*, *Adiantum pedatum*, *A. capillus-veneris*, *Cheilanthes lanosa*.

11. ASPLENIACEAE*

1. Leaves dimorphic, the fertile leaves with sporangia borne inside of rolled up, much contracted leaflet segments; sterile leaves coarsely lobed with netted veins throughout. . . . . 5. *Onoclea.*
1. Leaves not dimorphic, the sporangia borne exposed on mainly unmodified segments, the fertile segments never rolled up; veins free, or only partially anastomosing (or veins anastomosing and sori elongate and irregularly shaped following along the veins in *Asplenium rhizophyllum*).
   2. Sori round, without indusia; leaves herbaceous, broadly triangular. . . . . 1. *Thelypteris.*
   2. Sori round or elongate, with indusia; leaves of various textures, narrowly triangular to lanceolate.
      3. Sori elongate, linear or crescent-shaped, indusium attached to leaf along one side.
         4. Sori in two parallel lines along the midrib of the pinnae or the pinnules; veins anastomosing along the midrib and free near the lobe margin. . . . . 8. *Woodwardia.*
         4. Sori diverging at an acute angle from the midrib of the pinnae or pinnules; veins free.
            5. Scales of the rhizome with blackish, thick secondary lateral cell walls; at least the base of the stipe polished black or brown; sori straight. . . . . 6. *Asplenium.*
            5. Scales of the rhizome with similar thin lateral, dorsal and ventral cell wall faces; stipe base dull green, reddish or stramineus; sori straight, arched or hooked. . . . . 4. *Athyrium.*
      3. Sori round or kidney-shaped, indusium attached beneath sorus.
         6. Indusia composed of more or less separated flaps or filaments, these beneath and around the sporangial cluster like a cup. . . . . 2. *Woodsia.*
         6. Indusia composed of single units not divided into flaps or filaments, the shapes various.
            7. Indusium hood-like, attached by a broad base beneath the sorus and arching over the sorus from one side, not peltate or reniform. . . . . 3. *Cystopteris.*
            7. Indusium peltate or reniform.
               8. Indusium peltate, attached to leaf by a median stalk through sorus; sori confined to terminal constricted leaflets. . . . . 7. *Polystichum.*
               8. Indusium reniform, attached to leaf along the sinus; sori on unmodified leaflets. . . . . 1. *Thelypteris.*

1. THELYPTERIS Schmidel

1. Blade triangular.
   2. Leaves 1-pinnatifid, the pinnae lobed and with adnate wings along the rachis joining the pinnae. . . . . 1. *T. hexagonoptera.*
   2. Leaves 3-, 4-pinnatifid, the pinnae without wide attachment to the rachis. . . . . 2. *T. torresiana.*
1. Blade lanceolate to oblong-lanceolate.
   3. Blade base with 3–7 pairs of gradually reduced to rudimentary pinnae. . . . . 3. *T. noveboracensis.*

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* The illegitimate name "Aspidiaceae," or Polypodiaceae *sensu lato*, has often been applied to this group.

3. Blade base lacking rudimentary pinnae, the lowest pinnae only slightly reduced or not at all.
   4. Basal veinlets of adjacent pinna lobes running toward the sinus without uniting, or uniting at the base of the sinus.
      5. Rhizome short-creeping to suberect; leaves spreading, with soft pubescence, tending to become light green or yellowish at maturity, usually less than 0.5 m tall; veins simple. . . . . 4. *T. quadrangularis* var. *versicolor*.
      5. Rhizome short- or long-creeping to suberect; leaves stiffer, dark to light green at maturity, usually more than 0.5 m tall; veins simple or forked.
         6. Leaves light green; margins of fertile fronds usually revolute; lateral veinlets of segments mostly forked; segments cut nearly to the pinna axis. . . . . 5. *T. palustris*.
         6. Leaves dark green; margins usually flat; lateral veinlets of segments simple; segments cut only 0.5 to 0.75 of the way to the pinna axis. . . . . 6. *T. kunthii*.
   4. Basal veinlets of adjacent pinna lobes uniting below the sinus with a common vein extending to the base of the sinus.
      7. Petiole reddish; leaves tending to be slightly dimorphic, the earliest smaller, wider, spreading and sterile, the later ones more erect, narrower and fertile; the united vein to the sinus long, the pinnae being shallowly lobed. . . . . 7. *T. dentata*.
      7. Petiole yellowish; leaves not dimorphic; united vein short, the pinnae deeply lobed. . . . . 4. *T. quadrangularis* var. *versicolor*.

1. *T. hexagonoptera* (Michx.) Weath., Broad Beech Fern. Apr-Sept. Rich hardwood forests, ravines and loess hills; scattered throughout except YMD. *Phegopteris hexagonoptera* (Michx.) Fée—S, *Dryopteris hexagonoptera* (Michx.) C. Chr.—F. Fig. 4.

2. *T. torresiana* (Gaud.) Alston, Mariana Fern. May-Oct. Wet woods and stream banks; scattered in LPR, and Marshal and Warren Cos. *Dryopteris setigera* (Bl.) Ktze.—S(misapplied). Fig. 4.

3. *T. novaboracensis* (L.) Nieuwl., New York Fern. May-Oct. Rich woods; TRH. *Dryopteris novaboracensis* (L.) Gray—F. Fig. 4.

4. *T. quadrangularis* (Fée) Schelpe var. *versicolor* (R. St. John) A. R. Smith, Variable Maiden Fern. May-Oct. Rich deciduous woods and ravines; scattered in LBH, LPR, and Scott Co. *T. versicolor* R. St. John—S. Fig. 4.

5. *T. palustris* Schott, Marsh Fern. Jun-Oct. Wet roadsides, stream banks, marshy lake shores, bogs and wet woods; CPM, LPR, and Attala Co. *Dryopteris thelypteris* (L.) Gray-F; *T. thelypteris* (L.) Nieuwl.—S. Fig. 4.

6. *T. kunthii* (Desv.) Morton, Widespread Maiden Fern. Apr-Nov. Wet woods, roadsides, stream banks, and sandy flatwoods; CPM; LBH, LPR, and NCP. *T. normalis* (C.Chr.) Moxley—S. Fig. 4.

7. *T. dentata* (Forssk.) C. Chr., Tapering Tri-vein Fern. Jun-Aug. Edge of mixed woods and sandy loam; Forrest, Lauderdale and Pike Cos. Fig. 4.

This treatment follows that of Smith (1971).

2. WOODSIA R. Br.

1. *Woodsia obtusa* (Spreng.) Torr., Blunt-lobed Woodsia. May-Aug. De-

ciduous woods, sandy soil and sandstone outcrops; scattered in LBH, LPR, NCP, NPB, and TRH. Fig. 4.

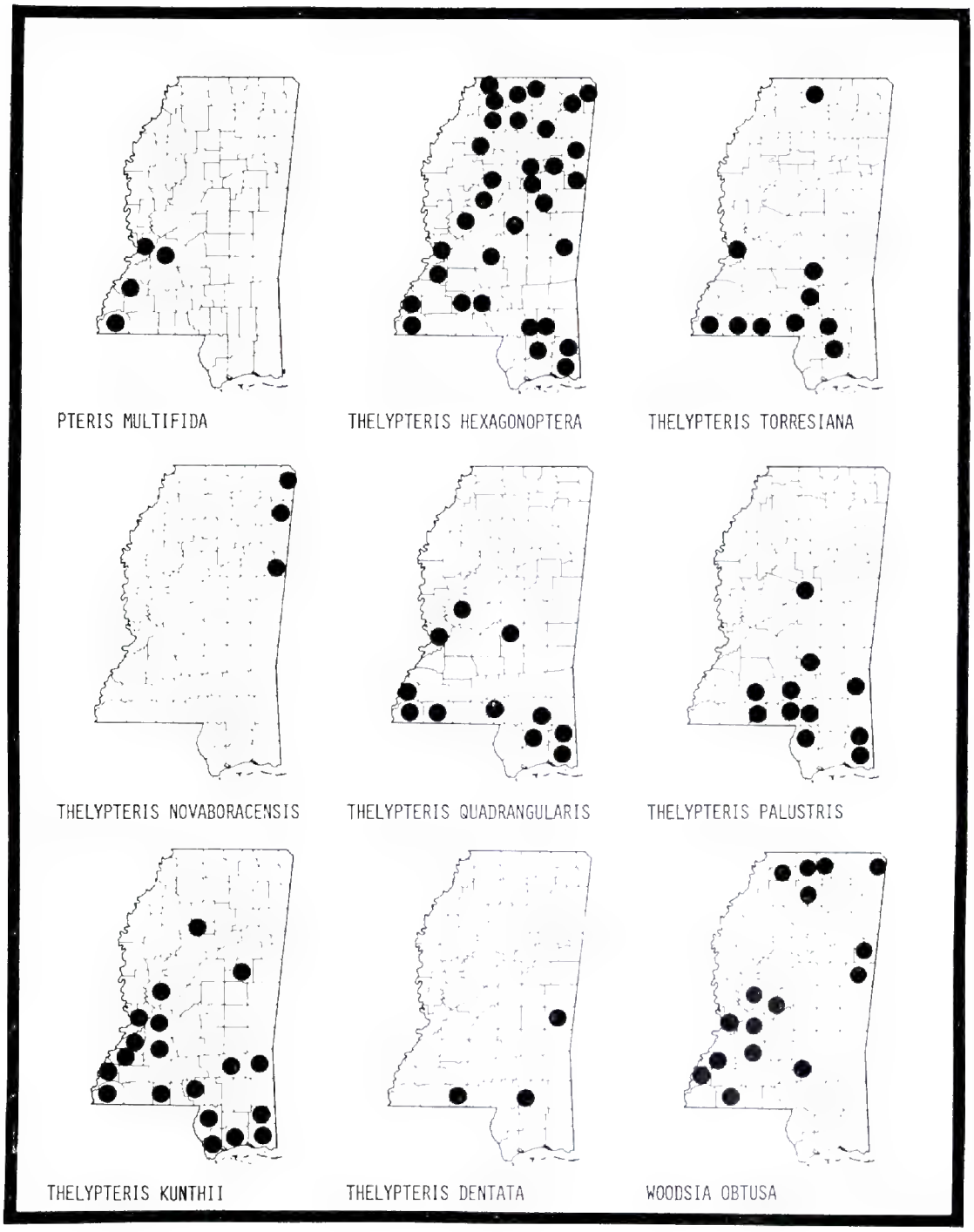

Figure 4. Distribution in Mississippi of *Pteris multifida*, *Thelypteris hexagonoptera*, *T. torresiana*, *T. novaboracensis*, *T. quadrangularis* var. *versicolor*, *T. palustris*, *T. kunthii*, *T. dentata*, *Woodsia obtusa*.

3. CYSTOPTERIS Bernh. Bladder Fern

1. *C. protrusa* (Weath.) Blasdell, Spreading B.F. Apr-Jul. Rich woods, ravines and loess bluffs; LBH and JP. *C. fragilis* (L.) Bernh. var. *protrusa* Weath.—F, G; *C. fragilis* (L.) Bernh.—S. Fig. 5.

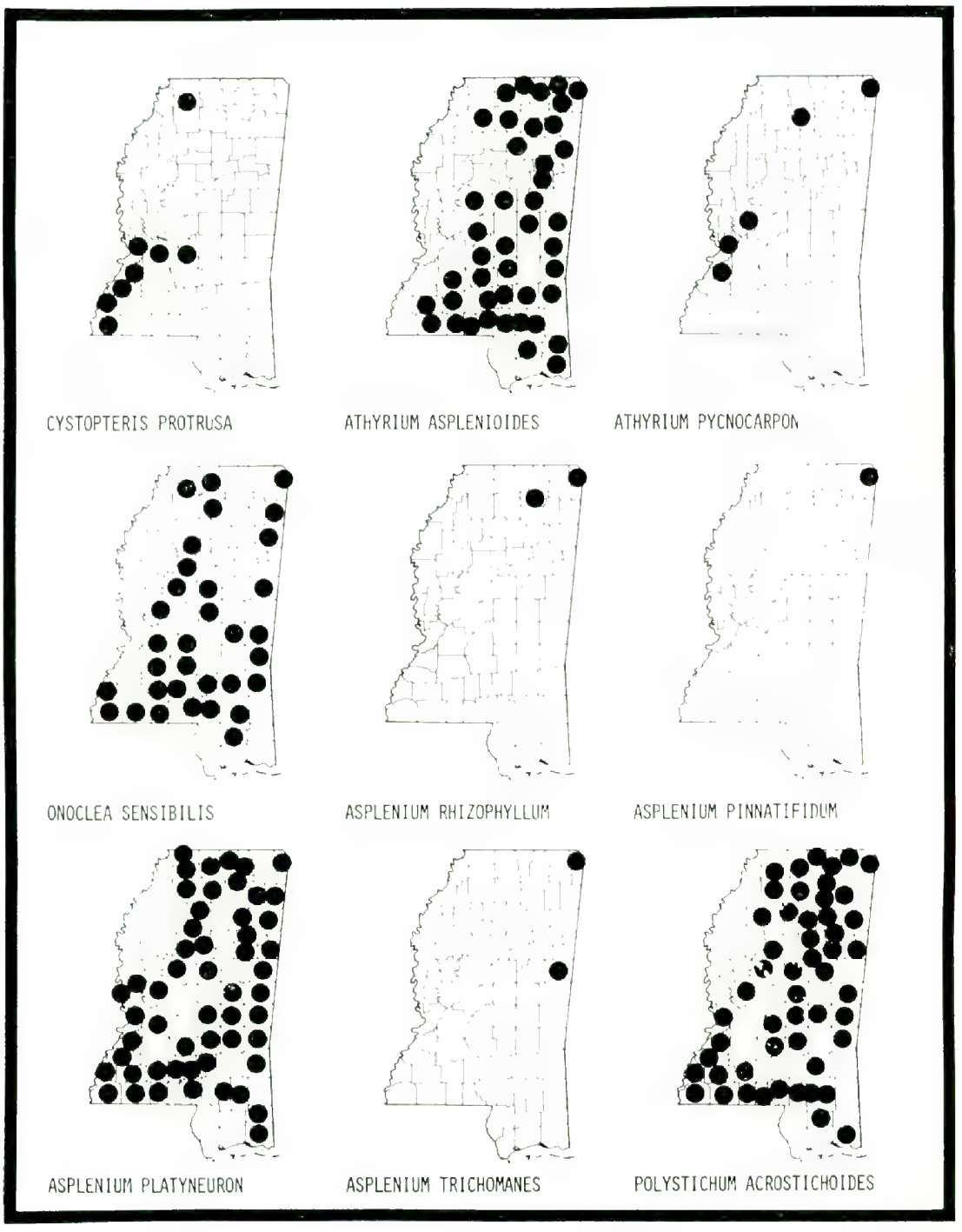

Figure 5. Distribution in Mississippi of *Cystopteris protrusa*, *Athyrium asplenioides*, *A. pycnocarpon*, *Onoclea sensibilis*, *Asplenium rhizophyllum*, *A. pinnatifidum*, *A. platyneuron*, *A. trichomanes*, *Polystichum acrostichoides*.

4. ATHYRIUM Roth

1. Leaves 2-3 pinnate; sori crescent-shaped, usually 1 mm or less long. . . . . 1. *A. asplenioides.*
1. Leaves 1-pinnate; sori nearly straight, usually 2 mm or more long. . . . . 2. *A. pycnocarpon.*

1. *A. asplenioides* (Michx.) Desv., Southern Lady Fern. May-Oct. Swamp forests, stream banks, marshes and lake shores, wet woods and ravines; throughout except YMD. *A. filix-femina* (L.) Roth var. *asplenioides* (Michx.) Farw.—F, G. Fig. 5.

2. *A. pycnocarpon* (Spreng.) Tidestr., Glade Fern. Jul-Aug. Rich woods and ravines; Claiborne, Lafayette, Tishomingo, Warren, and Yazoo Cos. *Homalosorus pycnocarpus* (Spreng.) Small—S. Fig. 5.

5. ONOCLEA L. Sensitive Fern

1. *O. sensibilis* L. Jul-Nov. Swamps, bogs, stream banks, wet roadsides, wet woods and ravines; throughout except YMD, CPM, FW, and PR. Fig. 5.

6. ASPLENIUM L. Spleenwort

1. Leaves undivided or lobed basally only; veins anastomosing. . . . . 1. *A. rhizophyllum.*
1. Leaves deeply lobed or pinnate; veins free.
   2. Blades deeply lobed at most, or pinnate at the base only; apex narrowly caudate. . . . . 2. *A. pinnatifidum.*
   2. Blades pinnate throughout; apex not caudate.
      3. Pinnae alternate, sessile, the bases usually overlapping the rachis; leaves somewhat dimorphic, the fertile ones upright and taller than the spreading sterile leaves. . . . . 3. *A. platyneuron.*
      3. Pinnae opposite, short stalked, the bases not overlapping the rachis; leaves monomorphic. . . . . 4. *A. trichomanes.*

1. *A. rhizophyllum* L., Walking Fern. May-Oct. Sandstone ledges; Tishomingo and Union Cos. *Camptosorus rhizophyllus* (L.) Link—F, G, S. Fig. 5.

2. *A. pinnatifidum* Nutt., Lobed S. May-Oct. Dry sandstone ledges; Tishomingo Co. Fig. 5.

3. *A. platyneuron* (L.) Oakes, Ebony S. May-Oct. Woods, pinelands, roadsides, pastures, sandy soil and sandstone outcrops; throughout. Fig. 5.

4. *A. trichomanes* L., Maidenhair S. May-Oct. Sandstone outcrops; Tishomingo and Noxubee Cos. Fig. 5.

7. POLYSTICHUM Roth

1. *P. acrostichoides* (Michx.) Schott, Christmas Fern. Apr-Aug. Rich deciduous pine and mixed woods, ravines, swamp woods, stream banks, loess and sandy soil; throughout except YMD. Fig. 5.

8. WOODWARDIA Sm. Chain-Fern

1. Leaves dimorphic, the fertile much contracted, the sterile pinnatified to pinnate, the leaflet bases widely adnate except at blade base; veins forming a fine network throughout. . . . . 1. *W. areolata.*
1. Sterile and fertile leaves alike, pinnate-pinnatifid, the leaflet bases fully

contracted throughout; veins free except along midribs of segments. . . . . 2. *W. virginica.*

1. *W. areolata* (L.) Moore, Netted C. F. Aug-Nov. Wet places, lake shores, stream banks, swamps, bogs, low woods and ravines; throughout except YMD and LBH. *Lorinseria areolata* (L.) Presl—S. Fig. 6.

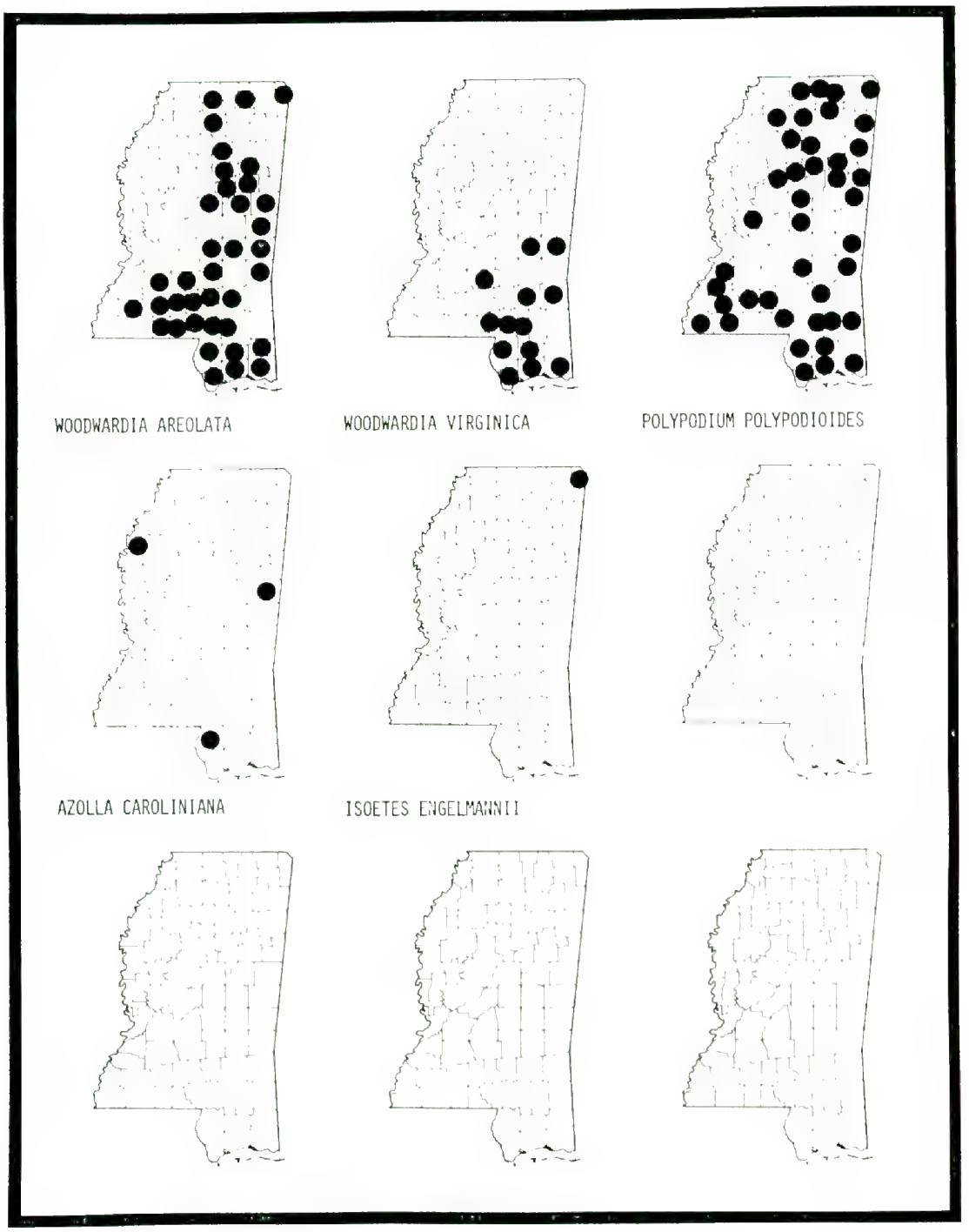

Figure 6. Distribution in Mississippi of *Woodwardia areolata, W. virginica, Polypodium polypodioides, Azolla caroliniana, Isoetes engelmannii.*

2. *W. virginica* (L.) Sm., Virginia C. F. May-Aug. Wet roadsides, pine barrens, bogs, swamp forests and wet woods; CPM, LPR, and NCP. *Anchistea virginica* (L.) Presl.—S. Fig. 6.

12. POLYPODIACEAE *sensu strictu*
POLYPODIUM L. Polypody

1. *P. polypodioides* (L.) Watt, Resurrection Fern. All year. On trees and rocks, hardwood, pine and mixed forests, cypress swamps, pastures, floodplains, and ravines; throughout except YMD. *Marginaria polypodioides* (L.) Tidestr.—S., *P. polypodioides* var. *michauxianum* Weath.—F. Fig. 6.

13. AZOLLACEAE
AZOLLA Lam. Mosquito Fern

1. *A. caroliniana* Willd. Jun-Sept. Floating or resting on mud, lakes, swamps, and ponds; Bolivar, Noxubee and Pearl River Cos. Fig. 6.

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THE CHIHUAHUAN DESERT SPECIES OF ERICAMERIA (COMPOSITAE: ASTEREAE)

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The purpose of this paper is to treat the Chihuahuan Desert species of *Ericameria* in advance of the flora being prepared for that region by M. C. Johnston et al. In this report one new combination is made and the taxonomy and distribution of the other four indigenous species are given. I concur with taxonomists who give *Ericameria* generic status (e.g. Johnston, 1970) rather than with those who treat it as a section in the genus *Haplopappus* (e.g. Hall, 1928). *Ericameria* comprises ca. 20 species of shrubs (Urbatsch, ined.), and California is its center of greatest species diversity.

The Chihuahuan Desert species of *Ericameria* are novelties. They stand apart from one another and from their California relatives in that each has a unique flavonoid complement and one or more extraordinary morphological features (Urbatsch, ined.). However, two characters, their zygomorphic disk corollas and their relatively long, thick style branches, give the Chihuahuan Desert species unity. Perhaps the pattern of diversity expressed by these species suggests that they are relicts that evolved from a common extinct ancestral group which also gave rise to the California species. Alternatively, the Chihuahuan Desert species may be recent evolutionary products that rapidly evolved in response to drastically changing environmental conditions. Certainly, the apparent morphological and chemical remoteness among the Chihuahuan Desert species and between them and the other Ericamerias offers a challenge to cladistic formulation.

Ericameria is closely allied with the genus *Chrysothamnus*, and it is often confused with the genera *Isocoma* and *Xanthocephalum*. Morphological features that distinguish the four genera are given in Table I.

Key to Species of Chihuahuan Desert *Ericameria*

1. Leaves acicular, non-resinous; ray flowers absent. . . 5. *E. purpusii*.
1. Leaves linear, not rigid and needle-like, usually resinous; ray flowers absent or present.
   2. Ray flowers present; heads with 7 or more flowers; phyllaries imbricate.
      3. Middle and upper phyllaries elliptic to obovate with a green to tan subapical patch.
         4. Leaves widely spaced, internodes 5–12 mm long, stems appearing "leafless"; heads with 7–14 flowers. . . 1. *E. pseudobaccharis*.
         4. Leaves crowded, internodes 1–4 mm long, stems leafy; heads with ca. 30 flowers. . . . . 2. *E. parrasana*.
      3. Middle phyllaries subulate with medial, prominent, dark-colored costa. . . . . 3. *E. laricifolia*.
   2. Ray flowers absent; heads with 3–7 flowers; phyllaries in subvertical files. . . . . 4. *E. triantha*.

SIDA 7(3): 298–303. 1978.

Taxonomic Treatment

1. ERICAMERIA **pseudobaccharis** (Blake) Urbatsch, comb. nov.—*Haplopappus pseudobaccharis* Blake, J. Wash. Acad. Sci. 40:47. 1950. TYPE: MEXICO: Coahuila: arid limestone hillside, Valle Seco, Sierra de la Paila, General Cepeda, 4 July 1944, *G. B. Hinton et al. 16546* (HOLOTYPE, US!; ISOTYPES, GH!, NY!)

Ericameria pseudobaccharis is known only from south central Coahuila, 1200-1500 m; it apparently flowers when conditions are favorable.

Ericameria pseudobaccharis was placed in synonymy with *E. triantha* by Johnston (1970) who had only limited material available. This species remained relatively unknown until James Hendrickson and co-workers rediscovered it at several different localities in Coahuila. The morphological range of variation for *E. pseudobaccharis* and *E. triantha* is now better understood and they are readily distinguishable. In *E. pseudobaccharis* the heads are solitary or disposed in racemes, radiate, 7–14 flowered, and have imbricate phyllaries, whereas in *E. triantha* the heads are in cymose clusters, eradiate, 3–7 flowered, and have phyllaries in subvertical files. The two taxa have only one flavonoid in common while they differ in twelve

TABLE 1. Comparison of Key Morphological Features that Distinguish *Ericameria* from Similar Genera.

Genus Character	Ericameria	Chrysothamnus	Isocoma	Xanthocephalum
leaf margins	entire	entire	serrate, lobed or entire	entire
phyllary arrangement	imbricate to sub-vertical files	vertical files	imbricate	imbricate
disk corolla tubes	gradually ampliate	gradually ampliate	abruptly inflated	gradually ampliate
pappus	bristles	bristles	bristles	scales or absent
heads	discoid or radiate	discoid	discoid	radiate

compounds (Urbatsch, ined.). The species are adapted to different habitats, *E. pseudobaccharis* occurs on limestone slopes and sometimes in gypseous areas, while *E. triantha* is commonly found in gypseous soils on desert flats.

Additional specimens examined: MEXICO: Coahuila, ca. 18 (air) mi NE of Tlahualilo, in Sierra de Tlahualilo, ca. 9 mi NW of Los Charcos de Risa, on small limestone peak, ca. 1.5 mi E of main peak, 30 Sep 173, *Hendrickson 13720* (LL); ca. 32 (air) mi NE of Tlahualilo, in the NW portion of the Sierra de las Delicias, in the first canyon south of the Puerto de las Sardines, on limestone, infrequent, 9 Aug 1973, *Hendrickson 12216* (LL); ca. 67 (air) mi SW of Cuatro Ciénegas, 1.5 mi SW of Las Delicias in E side of Sierra de las Delicias, 15 Aug. 1973, *Hendrickson 12467* (LL); ca. 62 (air) mi WSW of Cuatro Ciénegas, on N side of Sierra de los Organos, about 5 (air) mi SW of Cuestade Gallo, 8 Aug 1973, *Hendrickson 12110* (LL); ca. 9.2 (rd) mi S of El Hundido, in Izotal, frequent, 29 Sep. 1973, *Hendrickson 1376a* (LL).

2. ERICAMERIA PARRASANA Blake, Contr. Gray Herb. 52:26. 1917. TYPE: MEXICO: Coahuila, rocky slopes, Sierra de Parras, March 1905, *Purpus 1005* (HOLOTYPE, UC!; ISOTYPE, GR!).—*Haplopappus parrasanus* (Blake) Blake Contr. U.S. Natl. Herb. 23:1490. 1926.

Ericameria parrasana is known only from the rather obscure type locality and the one cited below. It apparently flowers when conditions are favorable.

Additional specimens examined: MEXICO: ZACATECAS: 2 km S of San Miquel on road to Cedros, 24° 55′ 50″N, 102° 07′W, 1570m; 1 Jul 1973, *Johnston, Wendt & Chiang 11542* (LL); same location as preceding; 22 Aug 1974, *Urbatsch et al. 1942* (LSU).

Ericameria parrasana was known only from the type collection until recently rediscovered by M. C. Johnston. Hall (1928) maintained that *E. parrasana* and *Haplopappus linearifolius* comprise *Haplopappus* sect. Stenotopsis, which Hall regarded as remote from sect. Ericameria. In my judgment both species in Stenotopsis belong to *Ericameria*. Although *E. parrasana* and *H. linearifolius* are similar in pappus color, head size, and leaf glands, they differ markedly in several other features such as style-branch morphology, capitulescence type, and flavonoid complements. The latter species appears to be closely allied to E. *cooperi* (Urbatsch, ined.). The affinities of *E. parrasana* are not readily apparent. Its flavonoids are more like those of *E. palmeri*. Clearly more study is needed before the relationships of *E. parrasana* are known with certainty.

3. ERICAMERIA LARICIFOLIA (A. Gray) Shinners, Field and Lab 18:27. —*Haplopappus laricifolius* Gray, Pl. Wright. 2 (Smithsonian Contribution Vol 5, art. 6): 80. 1853. TYPE: U.S.A.: NEW MEXICO, Hidalgo Co.: Guadalupe Pass, 5 Oct 1851, *Wright*, accession number *1188* (HOLOTYPE, GH!; ISOTYPES, MO! US!). *Aster laricifolius* (A. Gray) Kuntze, Rev. Gen. Pl. 318. 1891. *Chrysoma laricifolia* (A. Gray) Greene, Erythea 3:11. 1895. *Bigelowia nelsonii* Fernald, Proc. Amer. Acad. Arts 36:505. 1901. TYPE: MEXICO: CHIHUAHUA: Sierra Madre, 29 Sep. 1899, *Nelson 6494* (*HOLOTYPE*, GH!; photos of the type NY! UC!). *Ericameria nelsonii* (Fernald) Blake, Contr. Gray Herb. 52:26. 1917.

Ericameria laricifolia ranges from eastern San Bernardino Co., California

to Mohave Co., Arizona southeastward to northeastern Sonora, Mexico and Presidio Co., Texas. This species is often locally common, usually growing in stony soils of foothills and from crevices of canyon walls, 600-2500 m. Flowering is from mid-September into November; occasionally a few somewhat larger vernal heads are produced in April and May. *Ericameria laricifolia* is not closely related to the other Chihuahuan Desert species, but is allied to the California species, *E. pinifolia* and *E. brachylepis*.

Representative Chihuahuan Desert region specimens examined: MEXICO: CHIHUAHUA: mtns., near Ciudad Juárez, 1911, *Stearns s.n.* (NY); SW slope of Sierra de la Ranchería (on Rancho Candelaria) from the top down to a marble quarry at base, 31° 01'N, 106° 21'W, elev. 1500-2180 m, among steep crumbly slopes of extrusive igneous rock, 29 Oct 1972, *Chiang, Johnston, & Wendt 9950* (LL). NEW MEXICO: Grant Co.; collected on Bear Mt., near Silver City, elev. 6000 ft., 19 Sep. 1903, *Metcalfe 748* (ARIZ, GH, MO, NY, UC, US); Doña Ana Co.: Organ Mts., 18 Oct 1903, *Wooton s.n.* (ARIZ, MICH, NY); Hidalgo Co.: granite wash, N end of Big Hatchett Mts., 18 Aug 1954, *Castetter 9372* (SMU); Luna Co.: Filonda Mts., S slope, alt. 5800 ft, 8 Sep 1908, *Goldman 1485* (US); TEXAS: El Paso Co.: on mtns. above McKelligon Canyon, Franklin Mts., shrub about 3 ft tall, 16 Oct 1952, *Correll 15076* (LL, SMU, US); Presidio Co.: infrequent shrub on flats above Oso Crk., northside Chinati Mts., old Woods ranch, 18 mi NW of Shafter, 10 Nov 1946, *Hinkley & Warnock 46961* (GH, MO, TEX, UC).

4. ERICAMERIA TRIANTHA (Blake) Shinners, Field and Lab. 19:133. —*Haplopappus trianthus* Blake, J. Wash. Acad. Sci. 28:485. TYPE: U.S.A.: Brewster Co., frequent along road from Study Butte to Terlingua, Chisos Mtns. area. 31 Aug 1937, *Warnock 1126* (HOLOTYPE, US!; ISOTYPE, LL!).

Ericameria triantha occurs from Brewster Co., Texas southward throughout most of Coahuila, eastern Chihuahua, northeastern Durango, and northwestern Nuevo León from 700–1500 m. It is locally frequent in gypseous, calcarous, or saline habitats with gravelly to fine alluvial soils and flowers August to October and to some extent throughout the entire year.

The nearly vertical alignment of phyllaries of *E. triantha* suggests that it may well belong in the genus *Chrysothamnus*. However, anatomical studies by Anderson (1970) show that *E. triantha*, unlike *Chrysothamnus*, has the well developed secretory canals in its achenes and corollas characteristic of species in *Ericameria*. The flavonoid complement of *triantha* is most similar to that of *E. diffusa* (a species centered in Baja California) which Blake (1938) had suggested as its closest ally (Urbatsch, ined.).

Representative specimens examined: MEXICO: COAHUILA: west side of Luguna del Rey; 18 Oct 1971, *Bacon & Leverich 1197* (TEX); Laguna Salada, salt flats about lake; 11 Aug 1967, *Cole, Minckley & Pinkava 3645* (ASU); 6 mi W of La Víbora on small gypsum knoll near railroad, in Bolsón de Mapimí region of Chihuahuan Desert; 21 Sep 1972, *Henrickson 7868* (LL); 10 mi S of Castillón, 12 Aug 1970, *Johnston & Muller 195* (CAS, GH, LL, MICH): CHIHUAHUA: road from Castillón to Mula, via S. Salvador and Pirámide, 4 mi N of Mula; 21-22 Sep 1940, *Johnston & Muller 1439* (GH, LL); 5 mi E. of Carrillo, municipio de Jiménez; 15 Sep 1939, *Muller 3319* (GH, MICH, TEX, UC); DURANGO: road from Bermejillo to Zaragoza and north to Mohovano, 31 mi N of Zaragoza; 20 Sep 1938, *Johnston 7799* (GH, UC);

NUEVO LEON: 3 km from El Milagro and 10 km from Icamole on winding rd. between, 25° 55′ 30″N, 100° 47′W, 720 m, 5 Jul 1973, *Jonston, Wendt, Chiang 11612* (LL); U.S.A.: TEXAS: Brewster Co.: near Hot Springs, Big Bend Nat'l Park, limestone flag hills; 13 Sep 1961, *Correll & Jonston 24557* (LL, UC).

5. ERICAMERIA PURPUSII Brandegee, Univ. Calif. Publ. Bot. 4: 191. 1910. TYPE: MEXICO: COAHUILA: Cerro de Macho, June 1910, *Purpus 4479* (HOLOTYPE, UC!) *Haplopappus purpusii* (Brandegee) Blake, Contr. U.S. Natl. Herb. 23: 1491. 1926.

Ericameria purpusii is distributed from western Coahuila and southwestern Chihuahua south to central Durango at 1100–1200 m. It is sometimes locally frequent but usually uncommon on limestone hills, and sometimes in gypseous soils; it flowers in May and Aug-Sep.

The singularity of this species is manifest by its acicular, non-resinous leaves, and unique flavonoid complement (Urbatsch, ined.). *E. purpusii* is not readily accommodated in any existing genus, but its habit, involucral and pappus features, and chromosome number, n=9, place it closest to *Ericameria*. No useful purpose would be served by erecting a monotypic genus next to *Ericameria* for this taxon.

Hall (1928) doubtfully assigned *E. purspusii* to *Haplopappus* sect. Asiris (a taxon centered in the Rocky, Sierra, and Cascade mountains) based mainly on a single technical feature, lack of impressed resin pits. However, corolla and style branch features and consideration of its geographic occurrence place it closer to the other Chihuahuan Desert species of *Ericameria*.

Additional specimens examined: MEXICO: CHIHUAHUA: southern part of Las Pampas Ranch, Preson El Lindero, 27° 13′ 30″N, 104° 42′W, 1650 m, 26 Aug 1972, *Chiang, Wendt, Johnston 8936H* (LL); 6 km ESE of Rancho Chupaderos in the western part of the Sierrita del Rosario, 27° 10′ 30″N, 104° 37′W, 1575 m, 29 Aug 1972, *Johnston, Wendt, Chiang* 8984 (LL); COAHUILA: 5.5 mi E of Los Americanos, 27° 10′N, 103° 15′W, 1080 m, 2 Sep 1972, *Chiang, Wendt, Johnston 9117* (LL); ca. 29 rd. mi ESE of Esmaralda, 27° 10′N, 103″ 17′W, 20 Sep 1972, *Hendrickson 7846* (LL); road from San Antonia de los Alamos, 30 km E through low limestone hills to Buenavista, ca. 27° 30′N lat., W of Buenavista, 21 Aug 1941, *Johnston 8308* (LL); S of Laguna de Leche, 30 Aug 1941, *Johnston 8614* (LL); S of Matrimonio Viejo, 22 Sep 1941, *Johnston 9365* (LL); E of Americanos, 23 Sep 1941, *Johnston 9380* (LL); 2.5 km WNW of Hacienda Zacatosa, 27° 02′ 30″N, 102° 46′W, 1225 m, 7 May 1973, *Johnston, Wendt, Chiang 10906* (LL); 7.5 km N of Rancho Presa de Lumbre on rd. to Zacatosa, 27° 59′N, 102° 53′ 30″W, 1225 m, 7 Aug 1973, *Johnston, Chiang, Wendt, Hendrickson 12105* (LL); DURANGO: 52.5 km W of Ceballos on rd. to Villa Hidalgo, a few km due S of Buen Día, 24° 19′N, 104° 30′W, 1400 m, 31 Oct 1972, *Chiang, Wendt, Johnston, 9984* (LL).

ACKNOWLEDGMENTS

I am grateful to B. L. Turner, M. J. Johnston, James Hendrickson, and Ronald Hartman for their help with various aspects of this study. Also, I thank the curators of the various herbaria for their generous loans of specimens. Financial support received from NSF Grant GB-40362, a grant-in-aid

of research from the Society of the Sigma Xi, the LSU Department of Botany, and the Department of Botany, University of Texas, Austin, is acknowledged.

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NOTES

LOBELIA NUTTALLII (CAMPANULACEAE) IN SOUTHEASTERN LOUISIANA.—On 4 Jun 1976, *Lobelia nuttallii* R.&S. was discovered 12 miles northeast of Chalmette, Orleans Parish, Louisiana, during the botany field trip of the 1976 AIBS New Orleans meetings. The plants are characterized by tiny blue flowers, narrow stem leaves, and pedicels bracteolate at the base. This station extends the species distribution approximately 100 miles west from southern Alabama according to McVaugh ("North American species of *Lobelia*." Rhodora 38: 352-353, 1936) and Prof. Joseph Ewan, Tulane University, New Orleans (pers. comm.). Small (Manual of the southeastern flora, 1933) reported the species for Mississippi, but specimen documentation is apparently lacking.

The plants—fewer than 50 of them—were scattered along a sandy roadside bank above a saline marsh bordering the waters separating lakes Pontchartrain and Borgne. The annual habit of the species and the type of habitat in which the plants were found suggest that the species may have been unintentionally introduced from some more easterly region. The specimen (*Brooks 12099 and Hauser*) is on deposit at the University of Kansas Herbarium (KANU).—*Ralph E. Brooks and Larry A. Hauser, State Biological Survey of Kansas and University of Kansas Herbarium, Lawrence, KS 66044.*

NOTES ON COREOPSIS—Since the publication of my summary paper on eastern United States and Canadian *Coreopsis* (Sida 6(3): 123-215. 1976), a quantity of type material from PH has been called to my attention and a number of important distributional records have been collected. I am publishing this note to more critically document my summary paper and to add the distributional records to the literature. My thanks to the curators of APSC, FSU, GA, NCU, NO, PH, and WIS, who kindly asked me to annotate their material. Special thanks to Dr. J. A. Mears, who called my attention to the type material at PH, and to Dr. A. E. Radford, who pointed out the *C. rosea* collections from S. Carolina.

I. Important specimens at PH

1. *C. cardaminefolia* (DC.) Nutt. var. *angustiloba* T. & G.
   PH Acq. No. 918074 HOLOTYPE! (the name applies to the plant on the right). This = *C. tinctoria* Nutt. var. *tinctoria*
2. *C. corninsularis* Sherff
   Horn Island, Miss. *S. M. Tracy 8542.* 25 May 1903. U. Penn. Acq. No. 50382. ISOTYPE! This = *C. pubescens* Ell. var. *debilis* (Sherff) E. B. Smith
3. *C. X delphinifolia* Raf. var. *delphinifolia* forma *concolor* Sherff
   Tatnall Co., Ga. Moist swale in sandhills 3 mi NW of Reidsville. *A. Cronquist 5598.* 3 Aug 1948. PH Acq. No. 829747. ISOTYPE! This = *C. X delphinifolia* Raf.

4. *C. drummondii* (D. Don) T. & G. var. *wrightii* Gray
   C. Wright 1237. Texas. (N. Mex.) 1851. PH Acq. No. 918087. ISOTYPE! This = *Thelesperma* sp.
5. *C. floridana* E. B. Smith
   Low pine barrens, Apalachicola, Florida. *Biltmore Herbarium 2066c.* 22 Sep 1879. I mentioned a duplicate of this at NY as "clearly *C. floridana*" in my summary paper. This is also *C. floridana* E. B. Smith
6. *C. grandiflora* Hogg ex Sweet var. *harveyana* (Gray) Sherff forma *demareei* Sherff
   Bradley Co., Arkansas. Prairies. P. O. Warren. Elev. 150 ft. *D. demaree 1926A.* 7 Jun 1939. PH Acq. No. 816060. ISOTYPE! This = as determined.
7. *C. grandiflora* Hogg ex Sweet var. *pilosa* Sherff
   PH Acq. No. 556249. ISOTYPE! This = *C. lanceolata* L.
8. *C. harveyana* Gray
   Cliffs near Ft. Smith, Arkansas. *F. L. Harvey s.n.* June 1885. PH Acq. No. 918071. ISOTYPE! This = *C. tinctoria* Nutt. var. *tinctoria*
9. *C. heterogyna* Fern.
   Rich alluvial woods and thickets back of sand-beach of James River, below Sunken Meadow Beach. *M. L. Fernald & B. Long 8506.* 14 Jun 1938. PH Acq. No. 918086. ISOTYPE! This = *C. lanceolata* L.
10. *C. heterophylla* Nutt.
    PH Acq. No. 918072. HOLOTYPE! This = *C. lanceolata* L. (the plant on the left side of the sheet). Note: The name *C. heterophylla* Nutt. should be listed as a synonym of *C. lanceolata* L. (not *C. grandiflora* Hogg ex Sweet var. *grandiflora* forma *grandiflora*, as in my summary paper). Red River, Arkansas. *Nuttall s.n.* PH Acq. No. 918092. ISOTYPE! This = *C. grandiflora* Hogg ex Sweet var. *harveyana* (A. Gray) Sherff forma *harveyana*
11. *C. leavenworthii* T. & G. var. *curtissii* Sherff
    Dry ground along Suwanee River, Florida. *A. H. Curtiss 6734.* Oct. 1900. PH Acq. No. 918085. ISOTYPE! This = *C. leavenworthii* T. & G.
12. *C. linifolia* Nutt.
    Gates s.n. Alabama. PH Acq. No. 918070 and 917971 (2 sheets). ISOTYPES! This = as determined.
13. *C. nudata* Nutt.
    St. Mary's, W. Florida. *Baldwin s.n.* PH Acq. No. 918069. HOLOTYPE! and 918084 ISOTYPE! These = as determined.
14. *C. oniscicarpa* Fern.
    Nansemond Co., Virginia. Springy roadside bank north of Factory Hill. *M. L. Fernald & B. Long 9655.* 13 Oct. 1938. PH Acq. No. 918083. TOPOTYPE! This = *C. linifolia* Nutt.
15. *C. oniscicarpa* Fern. var. *simulans* Fern.
    Nansemond Co., Virginia. Sandy ditch at border of low woods northeast of Baines Hill School. *M. L. Fernald & B. Long 13827.* PH Acq. No. 918079, 918080, and 918081 (3 sheets). ISOTYPES!
    Same location. *M. L. Fernald & B. Long 14061.* 12 Sep 1941. TOPOTYPE! All of these = *C. linifolia* Nutt.
16. *C. palmata* Nutt.
    (St. Louis) Louisiana. PH Acq. No. 918068. HOLOTYPE! (plant on the right side of the sheet). This = as determined. Note: This takes precedence over the neotype that I named in my summary paper.

17. *C. rosea* Nutt.
(Nutt.) N. Jersey. PH Acq. No. 918067. HOLOTYPE! This = as determined. *Leavenworth s.n.*, Georgia. PH Acq. No. 917913. This = as determined. This Leavenworth collection indicates that the range of *C. rosea* did (but probably does not now) extend to Georgia, as stated by Nuttall.

18. *C. saxicola* Alex.
DeKalb Co., Georgia. Dry, light soil, Stone Mountain. *F. W. Pennell 4029.* 2 Aug 1912. U. Penn. Acq. No. 61145. ISOTYPE! This = *C. grandiflora* Hogg ex Sweet var. *saxicola* (Alex.) E. B. Smith

19. *C. stellata* Nutt.
PH Acq. No. 918065. HOLOTYPE! (the plant on the left). This = *C. major* Walt. forma *oemleri* (Ell.) Sherff

20. *C. tinctoria* Nutt.
(Nutt.) Ark. PH Acq. No. 918064. HOLOTYPE! Red River, Ark. PH Acq. No. 918073. ISOTYPE! These = *C. tinctoria* Nutt. var. *tinctoria*

21. *C. wrayii* Nutt.
(Nutt.) N. Carol. PH Acq. No. 918063. HOLOTYPE! This = *C.* X *delphinifolia* Raf. Note: *C. wrayii* Nutt. should be listed as a synonym of *C.* X *delphinifolia* Raf., not as a synonym of *C. major* Walt. forma *oemleri* (Ell.) Sherff as in my summary paper. This specimen indicates that N. Carolina is (or was) in the range of *C.* X *delphinifolia* Raf.

II. Important distributional records

C. grandiflora Hogg ex Sweet var. *grandiflora* forma *grandiflora*
FLORIDA: Liberty Co.: *Godfrey 75183* (FSU, UARK), first record for Florida. MISSISSIPPI: Alcorn Co.: *Temple 3169* (GA); Lawrence Co.: *Temple 12283* (GA), first records for Mississippi.

C. grandiflora Hogg ex Sweet var. *saxicola* (Alex.) E. B. Smith
MISSISSIPPI: Alcorn Co.: *Temple 6597* (GA), first record for Mississippi.

C. nudata Nutt.
LOUISIANA: St. Tammany Parish: *Lemaire 1013* (NO), first record for Louisiana.

C. rosea Nutt.
S. CAROLINA: Aiken Co.: *Massey & Massey 2983* (NCU, 2 sheets; GA), *Massey & Massey 3020* (NCU). These rather surprising collections extend the present range of *C. rosea* to S. Carolina.

C. tinctoria Nutt. var. *tinctoria*
FLORIDA: Dixie Co.: *Godfrey 75270* (FSU, UARK), *Kral 5407* (NO); Sumter Co.: *Kral 6846* (GA); Taylor Co.: *Lazor 3758* (GA).
Note: All four of these collections from Florida have entirely yellow ligules, suggesting contamination with *C. leavenworthii* T. & G. A specimen of *C. leavenworthii* T. & G. I observed recently from Hernando Co., Florida (*Kral 6795*, GA) had the upper leaves pinnate and the achene aristae rather short, suggesting contamination with *C. tinctoria* var. *tinctoria*. This northwestern area of the Florida penninsula includes the type locality of "var. *curtissii* Sherff," and is evidently an area of intergradation between *C. leavenworthii* and *C. tinctoria* var. *tinctoria*.

Correction

On p. 148 of my summary paper, in line 8a, "Bot. S. C. & Ga. 2:44." should read: Bot. S. C. & Ga. 2:441.—*Edwin B. Smith, Department of Botany & Bacteriology, University of Arkansas, Fayetteville, Arkansas, 72701.*

CYPERUS SURINAMENSIS (CYPERACEAE): NEW TO ARKANSAS, KANSAS, AND OKLAHOMA—Collections of *Cyperus surinamensis* Rottb. in the United States are thus far known only from the Coastal Plain, ranging from South Carolina to Florida, west to Texas. Additional collections can now be reported from inland states of Arkansas, Kansas, and Oklahoma. ARKANSAS. Jefferson Co.: growing in mud near water, on NW corner of Boyd's Island, Arkansas River, Pine Bluff, *Locke*, 31 Aug 1975 (UARK). KANSAS. Harvey Co.: wet roadside ditch, sandy soil, 3 mi E and 2 mi N of Burton, *Stephens 19167*, 11 Oct 1967 (SMU, UARK). Reno Co.: SW of Hutchinson, *Shanks*, 27 May 1945 (SMU). OKLAHOMA. Choctaw Co.: above water line of Roebuck Lake in sandy soil, *Murphy*, 8 Jul 1952 (SMU). Marshall Co.: infrequent, margins of Lake Texoma, Univ. of Okla. Biol. Sta., *Goodman 5761*, 4 Aug 1953 (SMU). Texas collections are common from the coast and inland to Robertson Co. but rare from north central Texas (Tarrant & Dallas Cos., ca. 400 miles inland). The Oklahoma collections are ca. 80 miles north of this; those in Kansas, ca. 300 miles. This puts Kansas collections ca. 750 miles inland, somewhat out of the expected range of the species. Specimens reported here were misidentified as *C. acuminatus*, a species superficially resembling *C. surinamensis*—*Barney Lipscomb, Herbarium Southern Methodist University, Dallas, TX 75275.*

NOTICES

The Department of Botany, Smithsonian Institution, was recently asked by the Soil Conservation Service of the United States Department of Agriculture to produce an updated, revised, and corrected edition of the *National List of Scientific Plant Names*, which was originally issued by the Service in 1971. The Department of Botany has agreed to undertake the revision of this checklist and looks forward to bringing the list to the attention of a much wider circle of botanists and conservationists.

A special support staff has been assembled to work on this project for a period of two years, after which the Soil Conservation Service and Smithsonian Institution will publish the results as an authoritative catalogue of correct scientific names of all vascular plant taxa (including subspecies and varieties) in North America, Hawaii, Puerto Rico and the Virgin Islands.

In the process of revising the list, intensive use will be made of the periodical literature and floras which have appeared in the intervening years since 1971. A very significant aspect of this work will be our invitation to the taxonomic community to participate in this endeavor. We will be soliciting the highly valued cooperation of numerous botanical colleagues early in 1978.

The need for a standard, efficiently produced, and more widely available checklist of North American vascular plants has long been felt by all. The opportunity now exists for filling this vacuum with a publication in a reasonable amount of time. In the published revision, full acknowledgment will be given to the people making individual contributions of data.

Please address your correspondence regarding the checklist to: The Chairman, Department of Botany, National Museum of Natural History, Smithsonian Institution, Washington, D. C. 20560.

The magnifications given in the legend of the illustrations of *Marsilea mucronata* (SIDA 7:219. 1977) should be changed to 10X and 1.25X.

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A SYNOPSIS OF FUIRENA (CYPERACEAE) FOR THE AMERICAS NORTH OF SOUTH AMERICA

ROBERT KRAL
Department of Biology, Vanderbilt University
Nashville, Tennessee 37235

Fuirena (Cyperaceae) comprises an estimated 30 species, mostly warm-temperate or tropical, in both hemispheres. All are plants of high hydroperiod soils, most are heliophytes. Of the 13 taxa treated here one is a rare ruderal, 6 are found mostly in grass-sedge formations such as found in interdunal swales toward the seacoasts or in "sweet" marshes or seeps inland and the remainder are on highly organic sands or peat mucks of swamps and bogs. Several are wetlands weeds. Only two are annual. No economic value is known for the species.

Some cyperologists consider *Fuirena* to be a part of *Scirpus*. Whether this is true or not is not belabored here; the plants are distinguishable from other sedges through a combination of all or most of the following characteristics: (1.) Culms generally leafy, the leaves with erect, scaly, ciliate ligules and in 3 ranks; spikelets either in terminal clusters or in a compound of sessile or pedunculate, both terminal and axillary, glomerules. (2.) Scales of spikelets numerous, spirally arranged, awned, with the awn of many species spreading or recurved, imparting a "bristly" look to the spikelet. (3.) Perianth usually of 6 bristles, 3 of which are broad-bladed, *or* all 6 lacking blades, *or* of 3 bladed members with 3 reduced to nubs, or vestigial; most of the species in this treatment have some bladed perianth members, but it is interesting to see in the same small group of species a complete range of reduction in perianth. (4.) Style deciduous, but tip of akene produced upward into a definite beak whose apex is frequently tuberculate-papillose or scabrid. (5.) Akene trigonous, usually stipitate.

The most current treatment of North American *Fuirena* is that done by Svenson (1957). This is a very conservative approach based primarily on perianth characteristics. My own work is preliminary to a biosystematic study, and is intended merely to clarify some nomenclature, to present some additional observations on the gross morphology and the ecology, and to provide some additional distributional information not available to Svenson.

Acknowledgments

This preliminary study has been based primarily on field work stretched over a period of more than 10 years and concentrated in the southern United States and Mexico. During this period several hundred duplicate specimens have been collected and these will be distributed at the close of the entire

SIDA 7(4): 309—354.

study. Also during this period, and thanks to curators and staffs of the following named herbaria, more hundreds of specimens have been provided through loans, namely from: C, CHARL, FSU, GA, GH, KANU, LAF, LSU, MICH, MO, NY, P, PH, POM, RSA, SMU, TENN, TEX, UC, US. Several special collections made by Dr. Sidney McDaniel and Dr. D. Demaree have also been examined.

Grateful acknowledgment is here given to the following people: Dr. L.H. Shinners and Dr. W. Mahler who obligingly made available several valuable references and comments; to Dr. A. Skovsted and to Dr. A. Lourteig of C and P respectively, who either provided basic type materials or took time and trouble to make comparison with these: to all curators, herbarium staffs of institutions mentioned above for their kindness not only in provision of loans but for their patience in extending time periods of loans.

This investigation was supported in part by research grants GB-159, GB-3255 and GB-6688X to the author from the National Science Foundation.

Morphology

Habit. *Fuirena* is made up of both annual and perennial species, but only two of the taxa considered here are truly annual (*F. pumila*, *F. simplex* var. *aristulata*). Of these the former invariably dies at the end of one growing season, while the latter indicates at the southern portion of its range a tendency to sprout from very contracted overwintering rosettes. Root systems of all species are fibrous and diffuse. Seed of all species tends to germinate freely within two weeks of sowing in the greenhouse. Viability decreases sharply after one year from harvesting.

Rootstock. The two essentially annual taxa are weakly to strongly caespitose, the size of the clump and indeed the individual shoots are strongly dependent on a combination of soil moisture and (probably) on organic content of substratum. These, as would be suspected, have the slenderest roots and the shallowest root systems. The perennial species are all rhizomatous, but the growth patterns of these are of two sorts. In *F. scirpoidea*, *F. longa*, *F. repens* and *F. simplex* var. *simplex* the rhizomes are of relatively consistent width, are sheathed by short, scaly leaves, these at well separated or approximate nodes, in the case of the latter therefore imbricated. In the remaining perennials the rhizomes produce at approximate or distant intervals contracted ovoid, or nearly round cormous offshoots. These are progressively formed as the rhizome elongates and are particularly noticeable and full toward fall and in winter. Actually the whole structure is contracted culm plus an apex with very contracted preformed shoot leaves and all stages of formation and expansion are to be found on a single vigorous plant at any stage of the growing season. In the "bud" or "cormose" stage only the outer leaf is visible with the culm base, distended culm, the sheath and its minute blade enfolding the shoot apex. Through this pushes the rapidly elongating culm as the shoot elongates.

Culm. The culm of *Fuirena* is slenderest toward its base with the internodes contracted and sheathed. Its habit may be erect or quite lax and leaning. It is solid at the nodes, internodes terete or obtusely trigonous, progressively elongating upward, green, strongly and numerously longitudinally ribbed, with the vascular tissue peripheral and the large central area spongy-lacunar. Stomatal areas are confined to the narrow intervals between the ribs.

Leaves. The leaves are in 3 ranks and are comprised of a loose to rather tight cylindrical or 3-angled sheath, this multiribbed as in the culm, and a spreading to ascending linear or lance-linear, acute or narrowly tapering, blade. The sheaths are closed except toward the orifice, where there is produced an erect, usually pale brown, scarious, ciliate scale, the ligule. The upper and lower surfaces of the leaf blades are usually markedly different. The upper surface is as a rule smoother (though in some species it may still be quite trichomiferous and also minutely scabrid or papillose) with numerous longitudinal nerves moderately to slightly impressed, marked usually by a narrow and overlying band. Between the nerves are several rows of short to long-rectangular, longitudinally oriented, epidermal cells, these with side and end walls variously papillose, sometimes with end walls produced upward into dome-shaped processes; cell contents are comparatively translucent or made opaque with mucaceous or farinose material; stomata are not in evidence. If trichomes are present these may be short, unicellular or elongate-tapering, multicellular, glassy like hollow icicles: they may appear over the lumen or toward the endwalls. The lower leaf blade surface appears as an extension of the sheath surface, hence is strongly multicostate, the costal area comprised of shorter, glassy-walled cells, these often drawn out into short or elongated trichomes; cells of the intercostal areas are longer and thinner-walled, are longitudinally oriented in rows, these interrupted at more or less regular intervals by guard cell pairs and subsidiary cells, these likewise vertically oriented and appearing singly or in short transverse rows, slightly sunken or raised depending on the species. The lower surface of the leaf, in trichomiferous species, is usually hairier than the upper with the longer hairs again glassy and mostly found arising from costal cells.

Inflorescence. Spikelets in all species are comprised of very many ascending or erect, rather loosely imbricate, cymbiform scales, all but the lowest 2—3 bearing florets in their axils. The lowermost sterile bracts show transition to uppermost inflorescence bractlets, thus are more leaf-like and longer-tipped. The fertile bracts are rather uniform through the genus, tending to conceal all the floret except the tips of filaments and the anthers at anthesis together with the 3 hispidulous long-linear stigmas; most fertile bracts are of a broadly obovate, oblong to ovate type, broadly scarious margined, the backs rounded, with strongly raised nerves medially which converge to form a stiffish, prominent, erect to spreading or recurved mucro. Bract apices are rounded or slightly retuse, scarious, continuous across the mucro base adaxially (see

plates) and thus in position homologous to ligule. Bract margins and backs are in many species stiff-hairy, the hairs of various lengths but all straight and sharp. Common spikelet shapes are ovoid, lance-ovoid or cylindrical. Sequence of flowering within the spikelet is acropetal. When the fruit is mature the lowermost scales begin to absciss, exposing raised, "V" shaped scars. Old spikelets toward the end of a season therefore show a considerable length of rachis, in that flowering is indeterminate, but (rather interestingly) the spikelet tends to retain the same overall shape and dimensions. While extremes of *F. scirpoidea* may produce but a single spikelet at the culm tip, most produce them either in a terminal cluster or this plus pedunculate clusters from 1 or more of the subtending nodes. Arrangement of spikelets is basically cymose, with central spikelets of a group or unit maturing first. The smallest unit or cluster within the inflorescence is here termed a "glomerule." A single glomerule is subtended by 1 or more variously awned bracts the bodies of which are not much different than those of the spikelet; it is made up of few to many sessile or subsessile spikelets. The glomerule may be solitary or may form a compound with others in a diffuse system, usually with the primary axis or axis branch terminating in a sessile glomerule, this exceeded by pedunculate ones on peduncles of varying lengths. Each peduncle is sheathed at its base by a thin-tubular, oblique-orificed "prophyll" which by position is actually a ligule in that it is located at the inside of the junction between bract sheath and bract blade.

Flowers. The flower of *Fuirena* is perfect, sessile in the axil of a single bract (see plate for *F. breviseta*, fig. 4). A perianth is present and is basically biseriate. The commonest situation in our species is for the outer set of 3 to be simple bristles, these smooth or retrorsely barbellate, while the inner set of 3 bear broadish blades. In *F. incompleta* there are no bladed members, only 6 simple bristles or (in var. *obliterata*) the bristles very reduced or absent. In *F. camptrotricha*, *F. umbellata*, *F. repens* only 3 members develop prominently and these bear blades; the other set of 3 is reduced to short, tubercle-like processes or is absent. The most unusual perianth situation is displayed by the introduced *F. wallichiana*, whose perianth has a combination of short unbranched bristles and longer, flatter sparingly pinnately-branched segments.

The stamens range from 1 in the annual species to 3 in the perennials, the hypogynous, long-linear, flattened filaments at anthesis projecting the linear or oblong, basifixed, 2-locular anthers beyond the bract tips. The pollen is in cryptotetrads. Anthers are smallest in the annuals.

The ovary is tricarpellate, sessile or stipitate, the beaked apex prominent, jointed to an elongate smoothish style, this terminating in 3, exserted, long-linear, hispidulous stigma lobes.

The mode of flowering is similar to that observed for *Fimbristylis*, *Bulbostylis*, *Abildgaardia*. In a given flower the stamens are later to shed pollen than are the stigma lobes to receive. In a given spikelet, usually in a given

inflorescence, a series of spirals of florets will either be presenting *or* receiving pollen but not doing both simultaneously. The opportunity for selfing appears to be remote.

Fruit. The fruit is rather uniform through all our species, being a more or less stipitate akene, whose apex is a prominent linear or narrowly triangular beak (this sometimes papillose), whose body is broadly elliptic and trigonous with prominent rounded angles. The surfaces of the akene body between the wirelike angles are usually glassy, sometimes very delicately striated and cross-striated, only in *F. wallichiana* being cancellate.

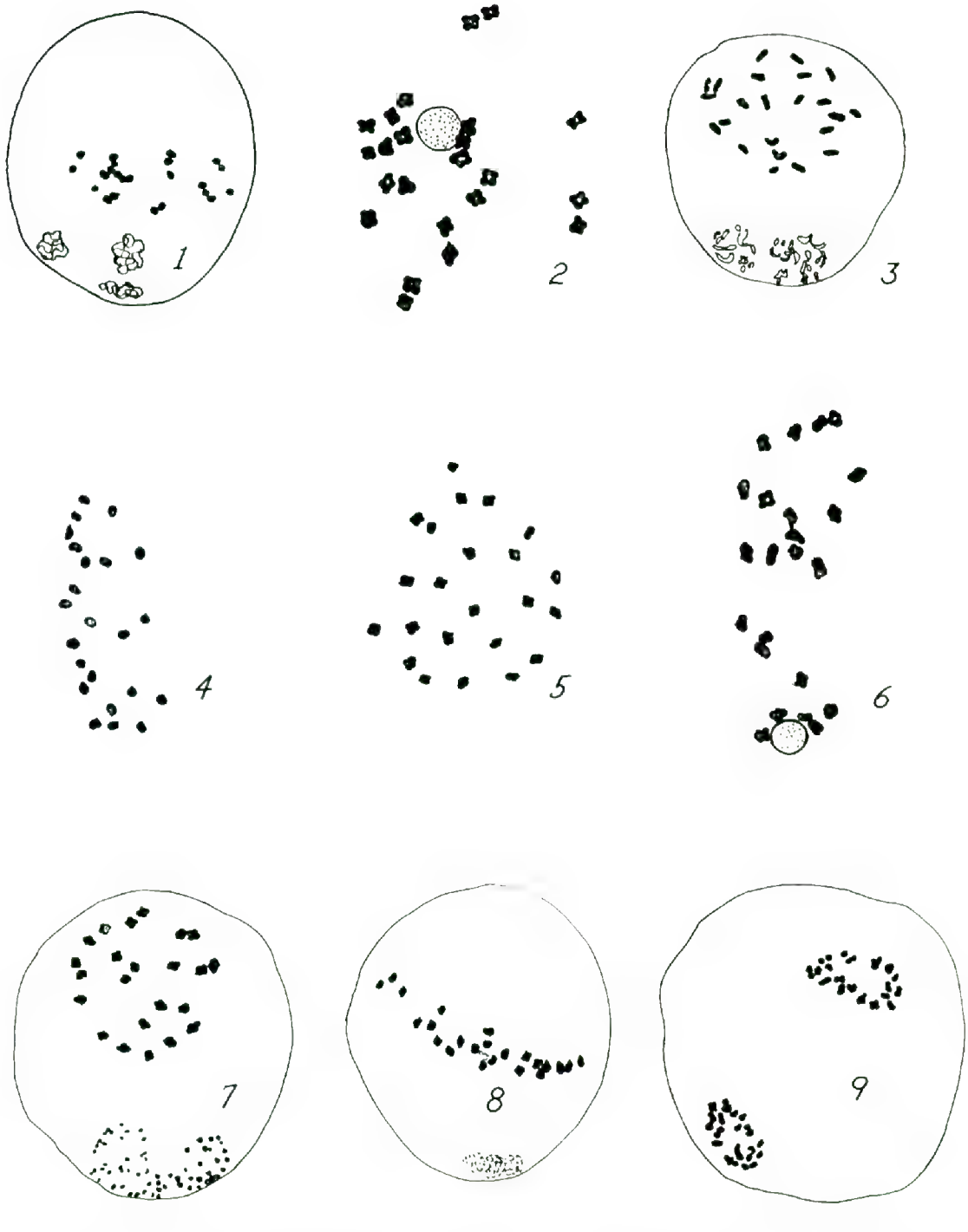
Cytology

Some preliminary studies have been made of microsporogenesis in a few species, sufficient to convince this writer that, at least in North America the mode of spore production is uniformly cryptosporic. Microsporogenesis proceeds as has been observed in *Fimbristylis* and related genera (Tanaka, 1939, 1941; Kral, 1971). The nucleus of the microspore mother cell meiotically divides and a tetrad is formed. Though low sutures appear to develop in the mother cell wall, cytokinesis does not take place. Instead, 3 of the 4 haploid nuclei move to one end of the sporocyte, lose both size and distinctness, while the fourth nucleus divides mitotically. Of these two products, one loses size and joins the other 3 reduced genomes. The remaining, or fifth, nucleus is thus the only functional product. (See illustrations of the various stages.)

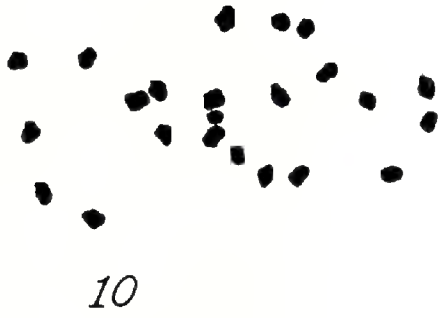
My own counts are still rather limited, and more will be published later on the subject as additional chromosomal studies are made. They now reveal a haploid number of 23 for *F. breviseta, F. longa, F. pumila, F. scirpoidea, F. squarrosa*, and *F. camptotricha* (mistakenly reported as *F. umbellata* in a prior, 1971, paper!). This count is so unusual and so unexpected that one wonders at the derivation of this condition; certainly it needs to be examined further. My limited inspection of chromosomes of *F. simplex* var. *simplex* has revealed two conditions for what appear to be phenotypically very similar sorts. In Texan material of the variety I have a haploid count of 15; in material of the same variety from the Gulf Coast of Mexico, the "conventional" count of 23 was made. As stated earlier, this information is so peculiar and conflicting as to warrant a more ample study.

Pollination. The flowers of *Fuirena* appear to be, with their exserted hispidulous stigma lobes and anthers, anemophilous. However, I was able to make one observation of what appeared to be bee pollination in a large population of *Fuirena scirpoidea* near Port St. Joe, Gulf County, Florida in July 1958. The bee was the common honeybee, and there was no question of abundance and persistence of these bees on and around the spikelets. It should probably be assumed that the visits were for pollen.

Hybrids. Some coastal plain habitats have up to 4 species of *Fuirena* growing together or in proximity. Yet the differences between the taxa, however, fine, appear to be consistent over the range. Such variation as occurs is also



MICROSPOROGENESIS IN FUIRENA. 1. *F. pumila* (*Kral 22886*, third division). 2. *F. pumila* (*Kral 22411*, prophase 1). 3. *F. breviseta* (*Kral 22905*, third division). 4. *F. breviseta* (*Kral 22887*, prophase 1). 5. *F. scirpoidea* (*Kral 22961*, prophase 1). 6. *F. scirpoidea* (*Kral 23005*, prophase 1). 7. *F. longa* (*Kral 22962*, third division. 8. *F. longa* (*Kral 23004*, third division). 9. *F. squarrosa* (*Kral 20668*, prophase 2). 10. *F. simplex* (*Kral 24997*, prophase 1). 11. *F. simplex* (*Kral 27810*, third division). 12. *F. longa* (*Kral 22962*, prophase 1). 13. *F. scirpoidea* (*Kral 22961*, metaphase 1).



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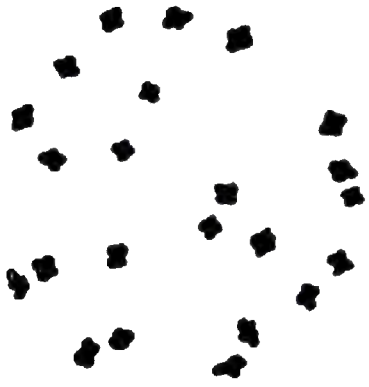

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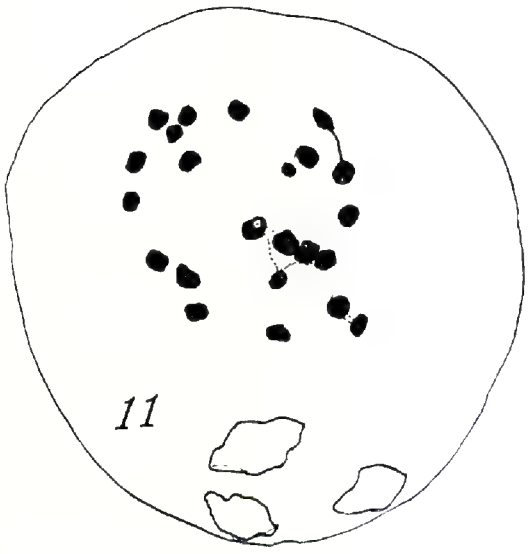

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consistent over the range. Further study is desirable in the case of *F. longa*, which has a morphology strikingly intermediate between that of *F. breviseta* and *F. scirpoidea* and may be of comparatively recent hybrid origin.

Taxonomic Treatment

In the treatment which follows, keys and descriptions are based on material collected from within the area of study, namely America north of South America. Generic limits are drawn only in the sense of the species treated. Keys and descriptions, while based in part on vegetative characteristics, are still centered on the characteristics of fruiting spikelets and healthy plants. Dimensions of spikelets are drawn only from the scale-bearing portion of rachis from which the scales have fallen, and this is not included in the measurement. Species are numbered in a single continuous sequence.

The large number of specimens examined in the course of the project makes it necessary to cite these collections separately. A list of citations is being prepared and, hopefully, will be available upon request to the writer at the time this paper appears.

The illustrations are numbered to correspond with the text treatment. Each plate shows a whole plant reduced together with enlarged views of florets, fertile bracts, nodes showing inner surfaces of lower parts of leaf blades. All illustrations are by the author.

FUIRENA, Rottb., Descr. & Ic. 70. 1773.
Vaginaria Pers., Syn. Pl. 1:70. 1805.

Perennial or annual, usually pubescent, caespitose or rhizomatous herbs, if rhizomatous with rhizomes short and thickened or extensively creeping and forking or producing in addition axillary cormous offshoots from which culms arise. Culms erect or leaning to 1 m tall, simple, stiff or wand-like. Sheaths of leaves loosely or closely investing the culm, strongly costate; blades either reduced to scale-like appendages or of a linear type, stiffly spreading or erect. Spikelets usually 1 cm or more long, ovoid, short-cylindrical, or ellipsoidal, arranged singly at culm apices or in terminal and axillary clusters, these made up of 1-several, sessile or variously pedunculate glomerules, or (less usual) the spikelets more pinnately arranged. Scales of spikelets numerous, spirally arranged, lowest 1—3 barren, the fertile mostly ovate, oblong or obovate, thinnish, the backs rounded, usually hairy, medially strongly to faintly costate, costae merging subapically to form a conspicuous, erect, or spreading stiffish, usually scabrid, awn. Perianth of most species 6-parted, with 3 simple bristles forming an outer whorl and 3 stipitate-bladed members forming an inner whorl; in some species the perianth is reduced to 3 bladed members, or comprised only of bladeless members or (rarely) lacking. Stamens (1-) 2—3 (-6), the filaments elongate, flattish, the anthers basifixed, oblong or linear, 2-locular, the pollen in "cryptotetrads". Style 3-cleft, disarticulating from an elongate gynoecial beak, stigma lobes linear, papillate-scabrid. Akene slightly to prominently stipitate, usually strongly 3-angled, body in outline rhombic or broadly ellipsoidal, the angles prominent, wirelike, the faces flat or slightly convex or concave, smooth or faintly cross-lined or cancellate, the apex a prominent narrowly triangular or linear beak, this sometimes expanded distally and there scabrid or papillose.

Key to *Fuirena* of the New World north of South America

1. Perianth in part or solely of bristles bearing broad blades; akene surface lustrous, smooth or very finely striate.
   2. Perianth comprised both of bladed and bladeless members, the bladeless bristles reaching at least to the middle of the stipe of the akene.
      3. The plants rhizomatous (often producing corm-like structure also); anthers at least 0.8 mm long.
         4. Culms slender, wand-like, smooth, on elongate, creeping, e-cormous rhizomes; mucro of fertile scales erect, mostly less than ½ of the

length of the scale body; sheaths of leaves either essentially bladeless or with longest blades rarely reaching 5 cm; backs of fertile scales usually with at least 5 prominent medial nerves.

5. Blades of upper culm leaves short, mostly mucro-like; apices of perianth scales mostly acute; spikelets mostly ovoid and 1—5, sessile in a terminal glomerule, with subtending bract shorter than the spikelets . . . . . 1. *F. scirpoidea* Michx., p. 318.

5. Blades of upper culm leaves longer, generally plane, to 5 cm long; apices of perianth scales acuminate; spikelets mostly lance-ovoid or lance-cylindric, narrowly acute; spikelets sessile in a terminal glomerule and frequently with pedunculate clusters as well; subtending bract usually longer than the spikelets. . . . . 2. *F. longa* Chapm., p. 319.

4. Culms usually stouter, usually with at least some prominent long hairs on leaf margins and/or sheaths, on elongate to short, cormous rhizomes; mucro of fertile bracts erect or spreading-recurved; leaf blades well developed, the longer ones (at least on healthy plants) rarely as short as 5 cm; backs of fertile scales usually with only 3 prominent medial nerves.

6. Mucro of fertile bracts at least ⅔ as long as the scale body, usually spreading or recurved-tipped; rhizomes cormous or ecormous.

7. Rhizomes producing corm-like shoot buds; perianth scale blades with apex obtusely angled, acute, acuminate or narrowly incurved-conic, not bearing a subapical apiculus or bristle.

8. Perianth bristles (sepals) short, incurved, smooth, their tips not reaching the bases of the perianth blades (petals); lowermost sheaths of leaves hispid, those of mid-culm or above becoming smooth; apex of perianth blades obtuseangled or acute, not conic or acuminate. . . . . 4. *F. breviseta* (Coville) Coville in Harper, p. 324.

8. Perianth bristles longer, more erect or even slightly spreading, smooth or retrorsely barbellate, their tips reaching at to the bases of perianth blades; all sheaths of leaves usually hispid or hispidulous or hirsute; apex of perianth blades either conic and very tumid, or acuminate.

9. Petal blades with an acuminate, thinnish or thickened, incurved apex; perianth bristles retrorsely barbellate; anthers no longer than 1.3 mm; plants of the Gulf and Atlantic Coastal Plain and inland to adjacent provinces east of the Mississippi River, with the cormous rhizome buds usually close-set. . . . . 5. *F. squarrosa* Michx., p. 327.

9. Petal blades tumid at maturity, narrowing distally to be conic and erect, sometimes apiculate as well; perianth bristles smooth; anthers ca. 2 mm long; plants of the Gulf Coastal Plain and Ozarks from La. and Ark. southwestward, with cormous parts of the rhizome often separated by distinct intervals of narrow internode longer than the corm width. . . . . 6. *F. bushii* Kral, p. 331.

7. Rhizomes simple, lacking corm-like shoot buds; perianth scale blades with apex flattish, or tumid, conic, blunt or emarginate, but usually producing a short or elongate, subapical dorsal bristle. . . . . 7. *F. simplex* Vahl, p. 332.

6. Mucro of fertile scales erect, seldom as long as ⅓ the length of the scale body; rhizomes cormous; robust plants from southern Mexico southward; also Cuba.
   10. Broader blades of leaves usually at least 1.5 cm wide, these and the sheaths mostly smooth except for stout-based spreading or ascending, stiff, long trichomes along the blade margins proximally; apex of perianth blades usually narrowly acute or acuminate, usually incurved, lacking a short, incurved, subapical dorsal bristle. . . . . 3. *F. robusta* Kunth, p. 322.
   10. Broader blades of leaves usually less than 1.5 cm wide, these and the sheaths usually hairy; apex of perianth blades usually tumid, generally blunter, and bearing a short, incurved, subapical dorsal bristle.
   . . 10. extremes of *F. camptotricha* C. Wr., p. 342.
3. The plants e-rhizomatous, usually annual; anthers mostly 0.5—0.6 (-0.7) mm long.
   11. Apex of perianth scale obtuse to retuse, bearing a dorsal-subapical bristle, this retrorsely barbellate; plants mostly of the prairie provinces.
   . . 7a. *F. simplex* Vahl var. *aristulata* (Torr.) Kral, p. 336.
   11. Apex of perianth scale acuminate, usually very narrowly so, usually incurved, not bearing a subapical bristle; plants mostly of the Atlantic and Gulf Coastal Plain with outliers in the Lake States.
   . . . . . 8. *F. pumila* (Torr.) Spreng., p. 338.

2. The perianth comprised only of bladed members (very reduced, tubercle or papilla-like bristles may sometimes be located in cycles inward or outward from the bladed members!).
   12. Claw of petal blades crimped; robust plants with stout cormous rhizomes and culms at least 0.5 cm thick; inflorescence often diffuse, comprised of many glomerules of spikelets.
      13. Mature petal blades flattish or thickened only marginally, over the nerves, and apically, the apex generally retuse-notched, from this notch arising a slender, coiled bristle.
      . . . . . 9. *F. umbellata* Rottb., p. 340.
      13. Mature petal blades with distal half tumid, inflated, the apex broadly conic or obtuse, papillose-scabrid, the bristle, if present, shorter, dorsal, subapical, erect or incurved.
      . . . . . 10. *F. camptotricha* C.Wr., p. 342.
   12. Claw of petal blades straight; slender lowish plants from slender, diffuse-creeping, e-cormous, elongate rhizomes, the culms never as thick as 2 mm; inflorescence usually a terminal cluster of sessile or subsessile spikelets. . . . . 11. *F. repens* Boeckler, p. 346.

1. Perianth comprising only bristles or with some producing narrow, lineal or lineal-lobed blades, or perianth essentially absent.
   14. Akene surface smoothish; perianth bristles simple or lacking.
      15. Perianth bristles usually 6, subequal, most of them well exceeding the middle of the akene body.
      . . . . . 12a. *F. incompleta* Nees var. *incompleta*, p. 348.
      15. Perianth bristles absent or reduced to short, unequal lengths, rarely exceeding the middle of the akene body.
      . . . . . 12b. *F. incompleta* Nees var. *obliterata* Kral, p. 350.
   14. Akene surface strongly cancellate; some or all of the perianth bristles bearing narrow, frequently pinnate or linear-lobed blades.
      . . . . . 13. *F. wallichiana* Kunth, p. 350.

1. FUIRENA SCIRPOIDEA Michx., Fl. Bor. Am. 1:38. 1803.
Vaginaria richardi Pers., Syn. Pl. 1:70. 1805.
Scirpus scirpoideus (Michx.) T.Koyama, Journ. Fac. Sci. Univ. Tokyo III (7):287. 1958.

Essentially glabrous perennial, 2—6 dm tall, from an elongate, often forking system of rhizomes just beneath the substrate surface, these pale, stoutish, with darker brown oblong scales overlapping the lower part of each internode. Culms erect, wand-like, arising like parts of a picket fence, usually very many and rather approximate along the creeping rhizome; internodes rather short at the culm base, elongating toward the inflorescence, subterete, multicostate, nodes swollen. Leaves mostly sheath, particularly those proximal on the culm, the sheaths loosely investing the internode, multicostate, tubular, firm, almost bladeless, producing at the oblique orifice a short (rarely longer than 3—4 mm) incrassate-margined, cusplike blade and an erect, scarious entire or short-ciliate, brownish oblique ligular orifice. Sheaths becoming shorter, internodes progressively longer upward, the ultimate one terminating in a single spike or a tight cluster of 2—5, subtended by a short-bladed bract shorter than the spikelets. Spikelets ovoid to lance ovoid, mostly 7—10 mm long (—1.5 cm), blunt or (rarely) acute. Fertile scales mostly ovate, oblong or obovate, the body 2.5—3.5 mm long, ciliate, thin, mostly tan, greenish-brown or reddish-brown, the backs rounded, puberulent or hirsutulous, with at least 5 strong median nerves, 3 convergent to form a short, stiff, erect mucro mostly less than ½ as long as the scale body and scabrid. Florets mostly 1.5—2.0 mm long, perianth 6-parted, calyx bristles retrorsely barbellate, reaching to the tips of the petal claws or slightly beyond; petal blades mostly ovate, about as long as the claws, thickened distally but somewhat compressed between the 3, raised basal nerves, apex usually compressed-conic, apiculate and also often slightly scabrid. Anthers ca. 2 mm long. Akene slender-stipitate, body trigonous with the angles pale, wirelike and the faces flat to slightly convex, a deep, lustrous reddish-brown or castaneous; stylar apiculus distally papillate or minutely scabrid. Fig. 1.

Sandy or sandy-peaty marshes, swales and seeps, sometimes in slightly brackish situations, along the seacoast from N.C. south to southern peninsular Florida and west in the Gulf Coastal Plain to southern Texas; Cuba. Map 1.

Type: "Florida." *Michaux.* Holotype at P compared with material sent from VDB. Dr. Alicia Lourteig, who made the comparison, found a good match.

2. FUIRENA LONGA Chapm., Fl. S. US. ed. 3:541. 1897.

Similar to *F. scirpoidea* but with rhizomes shorter, more branched and with culms frequently appearing tufted. Sheaths of mid and upper culms producing flat, short-linear blades, these longest at mid-culm or above,

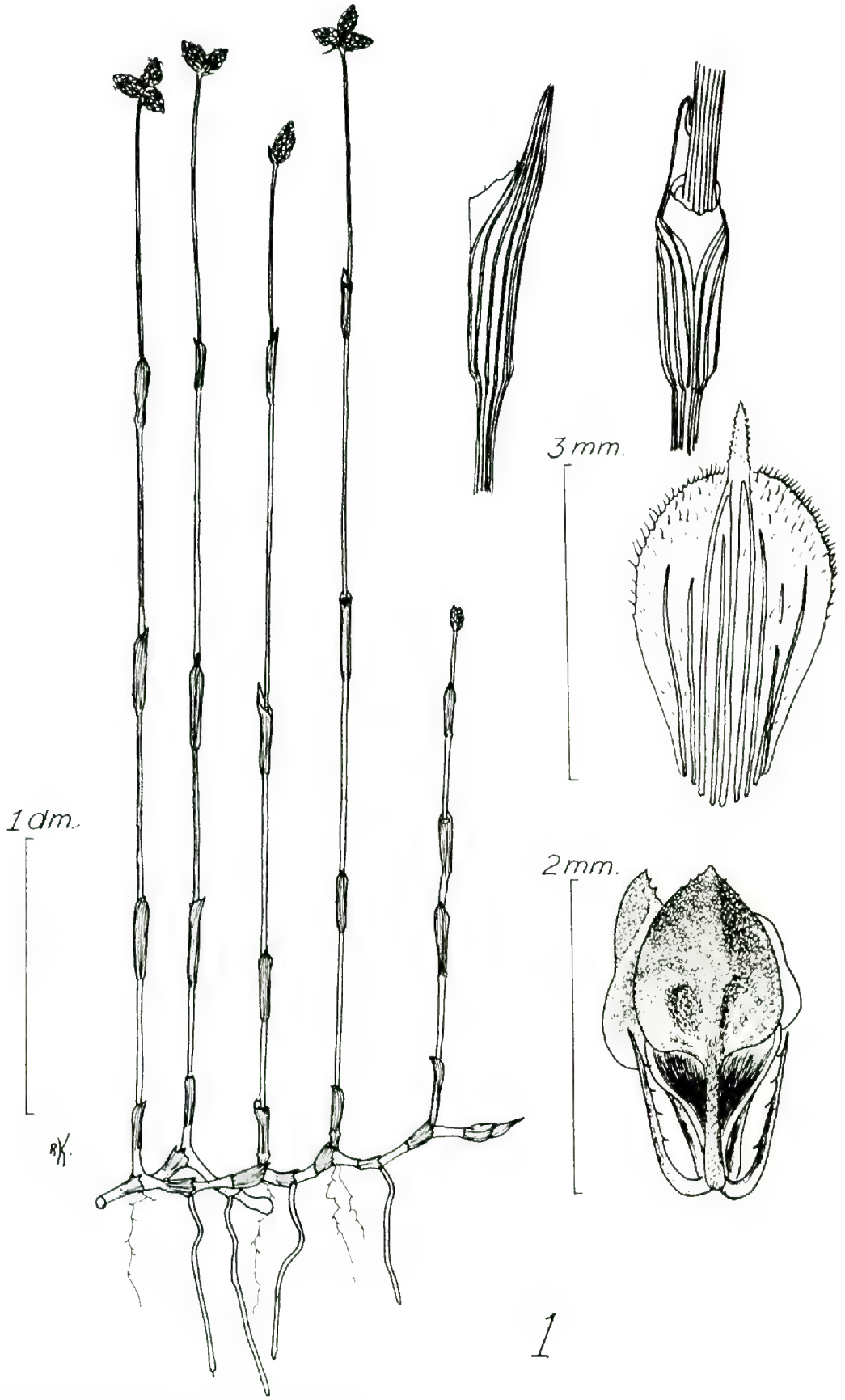
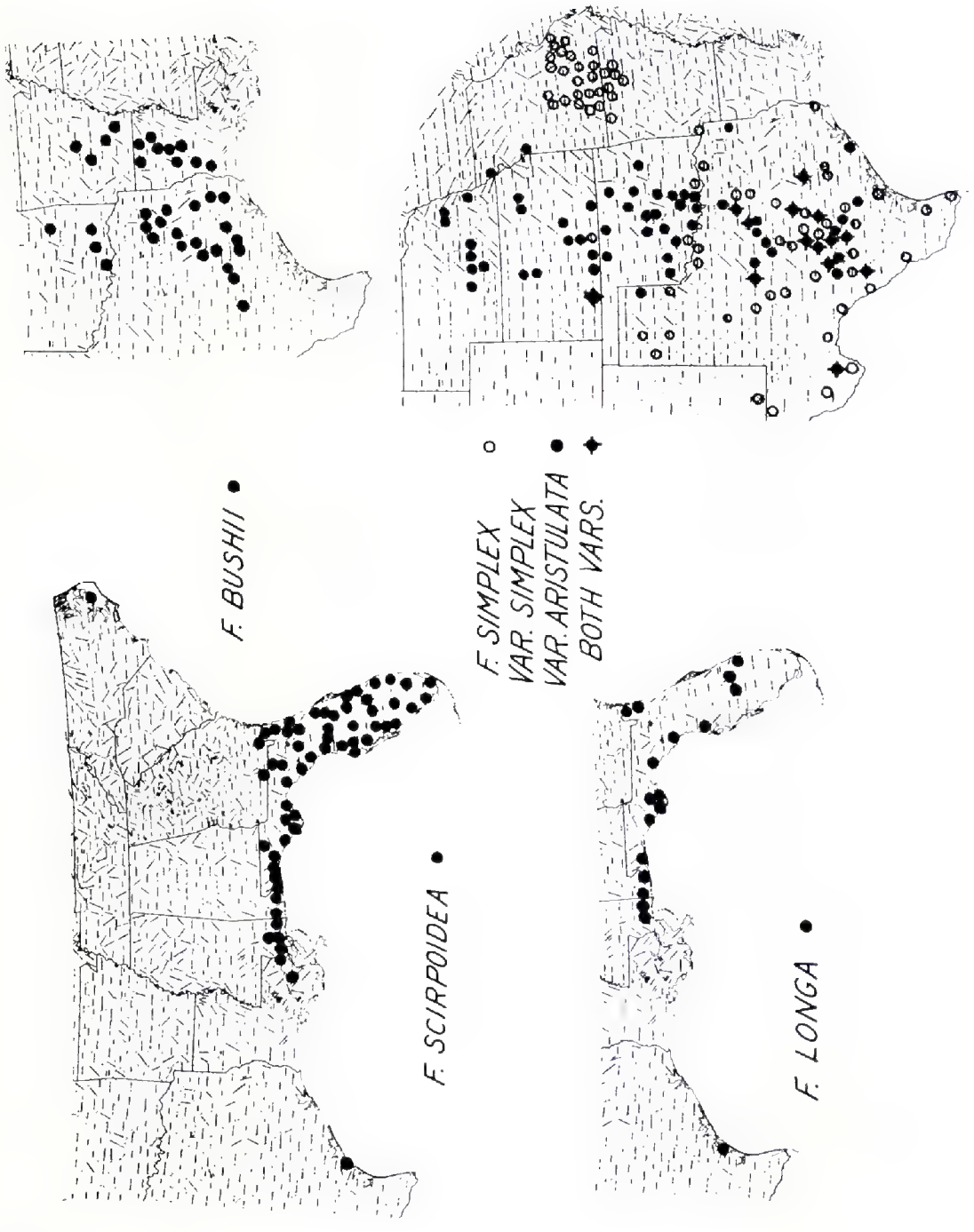


Fig. 1. *F. scirpoidea* (*Kral 32626*).



Map 1.

there 1.5—5.0 cm long, smooth or with the upper surface puberulent. Culms at level of inflorescence frequently hispidulous. Spikelet clusters (glomerules) often 2, subtended by bracts from nearly as long as to longer than the spikelets. Spikelets narrow, mostly cylindric-lanceolate or lance-ovoid, acute, more greenish. Fertile scales with body similar in length, mostly obovate, thin, hirtellous or puberulent, nerved medially as in *F. scirpoidea* but the excurrent mucro longer, sometimes slightly more than ½ the length

of the scale body. Perianth essentially as in *F. scirpoidea* but with petal blades often with a longer, narrower point. Anthers 1.3—1.5 mm long. Fruit as in *F. scirpoidea*. Fig. 2.

In habitats similar to those of *F. scirpoidea* and frequently mixed with it, in Florida and west along the coast to southern Mississippi; southern Texas. Map 1.

Type: Florida. Franklin Co.: "Apalachicola, *A. W. Chapman*"; GH! MO!

This, so often placed in synonymy of *F. scirpoidea*, has a very different look in the field. I have seen much of it in peninsular Florida and in the Gulf Coastal Plain west to southern Alabama. When seen mixed with *F. scirpoidea* it stands out at once because of its more appropriate shoots on shorter, more branching rhizomes, its longer leaf and bract blades, its narrower, more bristly, greener spikelets which appear in larger, more numerous clusters on the culms. I have yet to see it where there was not also some *F. breviseta* nearby and suspect without proof as yet that this entity has probably arisen as a hybrid between *F. scirpoidea* and *F. breviseta* or a similar species such as *F. squarrosa*. Certainly it is a vegetative intermediate. Tending to support this notion is the fact that but one locality for *F. longa* is presently known for Texas (Aransas County), disjunct from the furthest west Mississippi county by several hundred miles. From this same locality have also been collected *F. scirpoidea* and *F. breviseta*, these also representing considerable extensions of known range southwest.

3. FUIRENA ROBUSTA Kunth, Enum. Pl. 2:185. 1837.

F. bahiensis Lindl. & Nees; Nees in Mart. Fl. Bras. 2(1):108. 1842 (Brasil).
F. latifolia Steud. Syn. Cyp. 126. 1855 (Bahia, Brasil).
F. schizophylla C. Wright in Sauv. Anal. Acad. Ci. Habana 8:32. 1871. (Vuelta de Abajo, Cuba).

Perennial, with thick, spongy, erect culms to 16 dm tall, caespitose or set closely together in line on a short, stout, cormiferous rhizome. Lower leaves shortest, sheathing with oblique, ciliate orifices or with short-triangular blades; blades of mid-culm longest, oblong-linear or lance-linear, to 30 cm long and 3 cm wide, usually tapering from a cordate-clasping base to a narrowly acute apex, margins at least proximally with upward appressed, stiff, long trichomes, otherwise tuberculate-scabrid or entire, the surfaces smooth; sheaths smooth or rarely glabrescent. Inflorescence of 3—6 axillary systems of pedunculate, cymose clusters of glomerules from the upper nodes, the system interruptedly cylindrical, primary peduncles hirsutulous, triangular. Spikelets ovoid or lance-ovoid, ca. 5—6 mm long, reddish-brown or greenish-reddish-brown. Fertile scales ovate or obovate, rounded-ciliate, ca. 3 mm long, including a rigid, erect cusp shorter than the scale body, the backs with 3, rarely 5, strong medial nerves, these converging into an erect cusp usually less than ½ as long as the scale

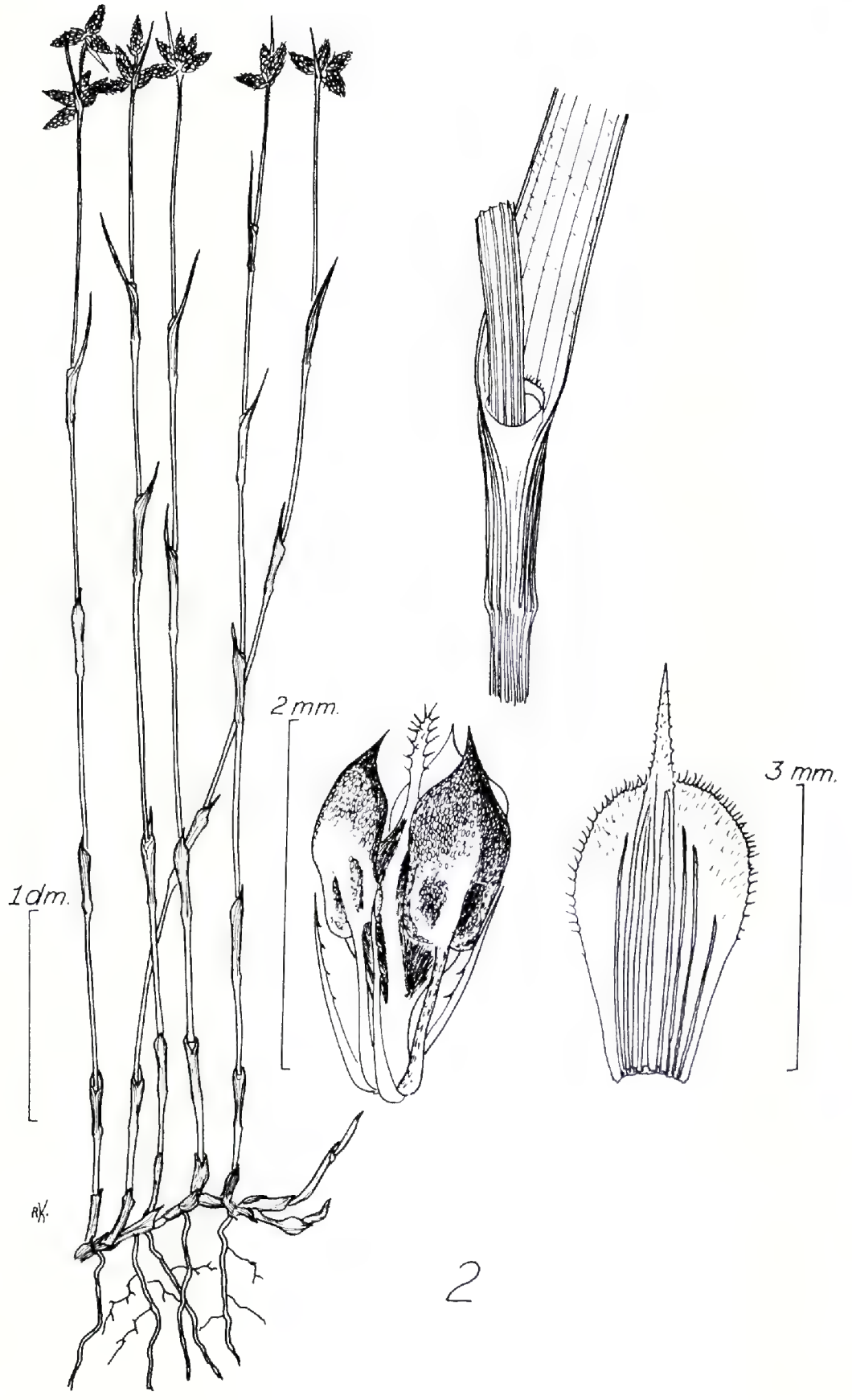


Fig. 2. *F. longa* (*Kral 23139*).

body which is overall glabrous to appressed-puberulent or strigillose. Perianth of 6 members, the outer set of 3 simple bristles, these about as long as the akene body or slightly longer and smoothish, the inner 3 (petals) bladed, clawed, ca. 2 mm long, the blades thickened, oblong or lance-oblong, obscurely 3-nerved, distally tumid, the apices incurved-apiculate or mucronate. Anthers normally 3, ca. 1.5 mm long. Akene ca. 1.5 mm long, stipitate-trigonous, body with angles prominent, wirelike, faces flat or slightly convex, smooth, lustrous, pale brown. Fig. 3.

Swamps and bogs in lowlands in Cuba, Panama; South America. Map 4.

Type: Type locality, southern Brasil. Material not examined by this writer. The description rendered by Nees in Martius (1842) of *F. bahiensis*, which is this species, is very good and matches in all regards. The type description by Kunth, based on material collected by Sellow, is brief but adequate to separate this from *F. umbellata* with which it might be confused.

F. robusta differs from *F. umbellata* mainly as follows: (1.) It is smoother than the latter, the sheath and leaf surfaces (very often even the inflorescence) smooth; in *F. umbellata* the same surfaces are often puberulent, more often hispidulous or hirsute. (2.) The margins of leaves, at least toward the base, have ascending or more often appressed, long, stiff hairs; in *F. umbellata* hairs of this area, if long, are less thick and are spreading. (3.) The spikelets are larger, wider, smoother. (4.) There is but 1 set of perianth segments in *F. umbellata,* these bladed, or crimped stipes, with the truncate or retuse, somewhat flattened blade apex bearing terminally a slender, coiled mucro; in *F. robusta* both sets of perianth are present, with stipes of bladed members mostly straight and with the usually swollen blade tips terminating acuminately in an incurved, not coiled, awn.

4. FUIRENA BREVISETA (Coville) Coville in Harper, Bull. Torrey Bot. Club 28:466. 1901.

   F. squarrosa Michx. var. *breviseta* Coville, Bull. Torrey Bot. Club 17:6. 1890.

Perennial from scaly rhizomes, the shoots arising from axillary, cormous offshoots. Culms to 1 m tall, usually 5 dm or lower, tufted, or approximate along the creeping, superficial rhizome, erect to ascending or leaning, internodes terete or something slightly angulate, multicostate, the lowest shortest, the uppermost longest, usually smooth except toward and in the inflorescence, where hispidulous. Leaf sheaths loosely cylindrical, strongly ribbed, the lowest longest, hispid, becoming shorter and (usually) smooth by mid-culm. Ligular orifice short-cylindric, submembranaceous, oblique, short-ciliate. Largest leaves at mid-culm or above, the blades spreading to reflected or erect, broadly lineal or linear-lanceolate, 5—15 cm long, 3—10 mm broad, flat, usually gradually narrowing from near the cordate-clasping base to the attenuated apex, margin slightly thickened-cartilaginous, usually

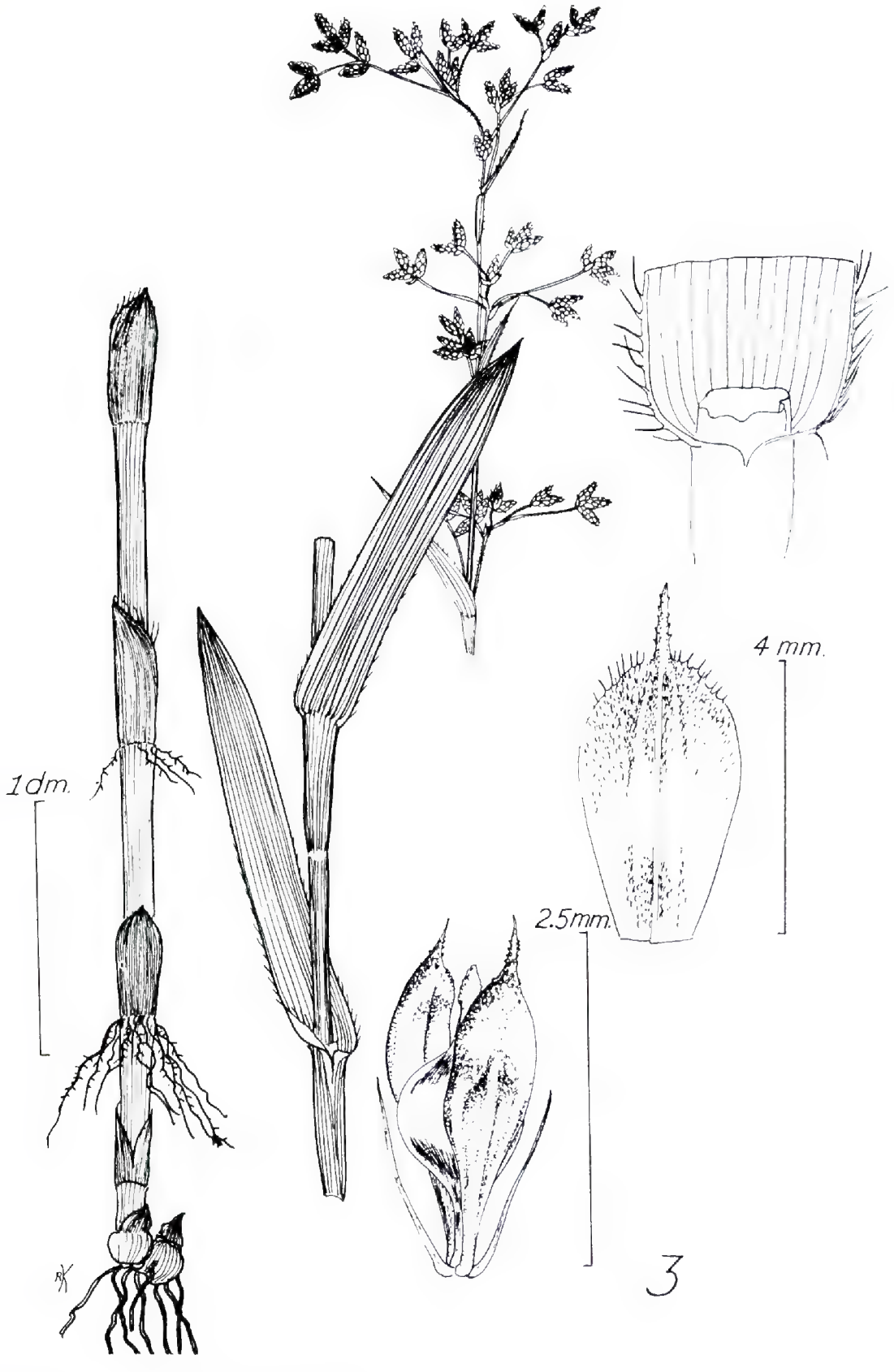
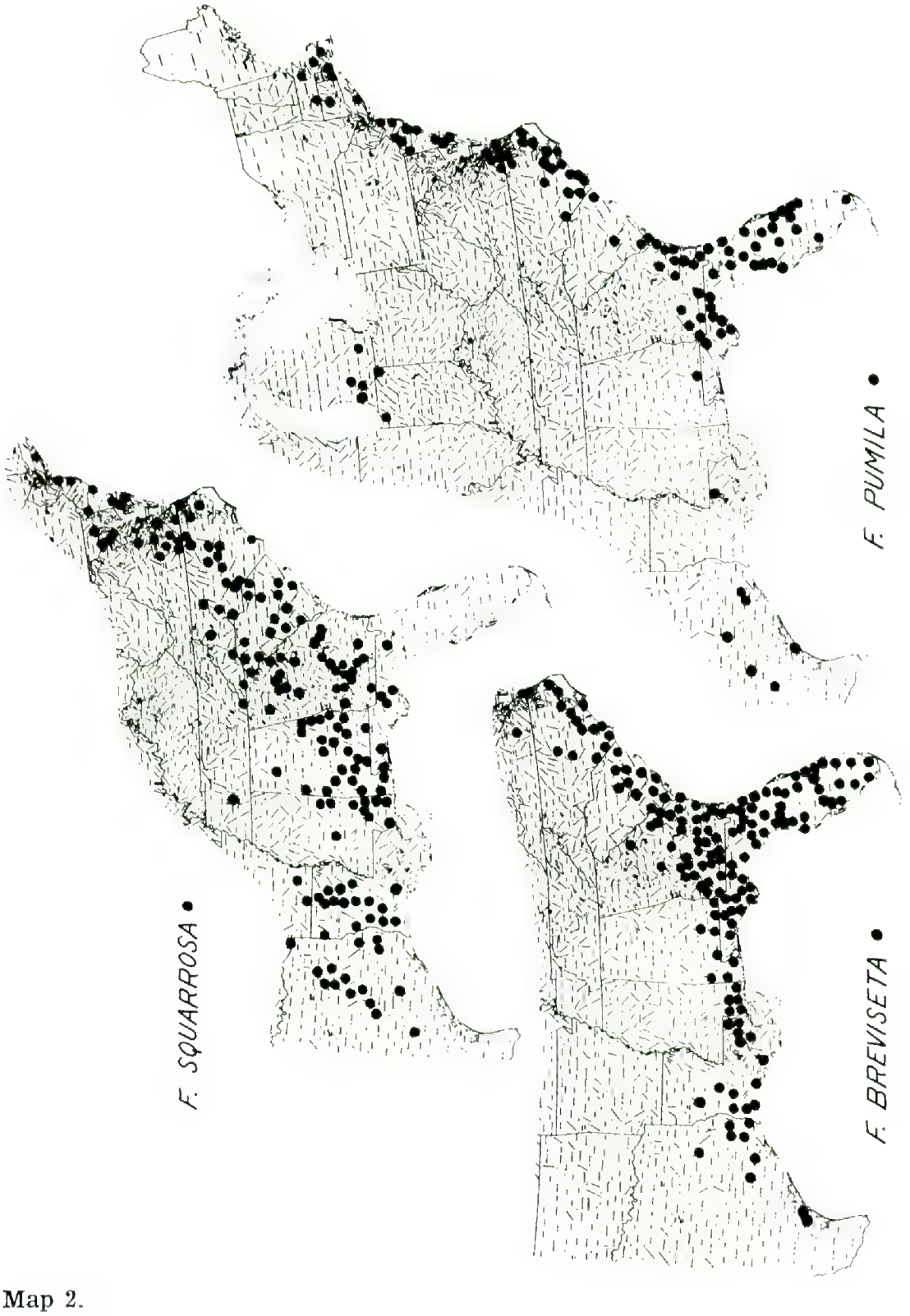


Fig. 3. *F. robusta* (*Bailey 256*).

spreading-hispid-ciliate at least proximally, the upper and lower surfaces smooth to sparsely strigose or strigillose or puberulent (usually nearly smooth), more strongly nerved beneath. Inflorescence a terminal dense to



Map 2.

open system of sessile and pedunculate glomerules of spikelets, primary and secondary peduncles angulate, hispidulous, often subtended by 1—3 additional ascending-pedunculate clusters of glomerules, all glomerules usually from 3—5 or more, digitately spreading spikelets. Spikelets ovoid, lance-ovoid, or cylindrical, mostly 1.0—1.5 (—2.0) cm long. Fertile scale body mostly oblong to obovate, 3.0—3.5 mm long, rounded to slightly emarginate, ciliate, thin, greenish brown or reddish-brown, backs rounded, hirsutulous or minutely scabrid, with usually 3, strongly raised, tan or greenish nerves medially, these converging to a stiffish, slender and spreading-recurved mucro ca. as long as the scale body and scabrid or hispidulous. Perianth of 6 members, the sepal bristles usually smooth, stoutish, incurved, short, rarely as long as the claw of the petal, rarely longer than the stipe of the akene. Petals ca. 2 mm. long, blade long-clawed, ovate or short - oblong, thickened except for the base, where showing 3 raised nerves, apically often incurved, broadly acute to obtuse, sometimes apiculate, usually minutely tuberculate-scabrid. Anthers 1.0—1.3 long. Fruit trigonous-stipitate, body with the three angles pale, wirelike, the faces flattish or slightly convex, a deep, lustrous brown, the stylar apiculus slightly broadened and hispidulous distally. Fig. 4.

Bogs, wet sandy places, seeps, savanna ditches, mostly Coastal Plain from southeastern Virginia south through Florida and west, in the Gulf Coastal Plain to southern Texas; Cuba. Map 2.

Lectotype: Florida. Duval Co.: low grounds, *A. H. Curtiss 3068*. DUKE! F! GH! MIN! NY! PH! TENN! A large set soon to be distributed and which compares well with the type is as follows: Alabama: Baldwin Co.: peaty pockets in sandy slash pine flatwoods just E of Orange Beach by Ala. 180, 22 Oct 1969, *R. Kral 38239*.

This species is placed by many authors in synonymy of *F. squarrosa*, a species admittedly very similar in habit. However, as Coville (1890) long ago recognized, it may be sorted easily from amongst a mass of mixed herbarium material of both, on the basis of its distinctive perianth characters, namely the long-stipitate, bluntish petal blades (in contrast to those of *F. squarrosa* which are narrowly acute to acuminate, born on shorter claws). When one becomes familiar with the species it may also be distinguished in the field by its stiffer, smoother foliage. While in *F. squarrosa* the leaf sheaths are pilose-hispid from base to apex of the culm, those of *F. breviseta* have only the lowermost sheaths hispid, the upper are almost invariably smooth. (In perhaps 1 instance in 100 the upper sheaths may be hispid!) The exceptions may represent chance hybrids, but even these show the perianth character of *F. breviseta*, and are so annotated.

5. FUIRENA SQUARROSA Michx., Fl. Bor. Am. 1:37. 1803.

F. squarrosa var. *hispida* Chapm., Fl. S. US. 514. 1860.

Perennial from scaly rhizomes, shoots arising from axillary, cormous

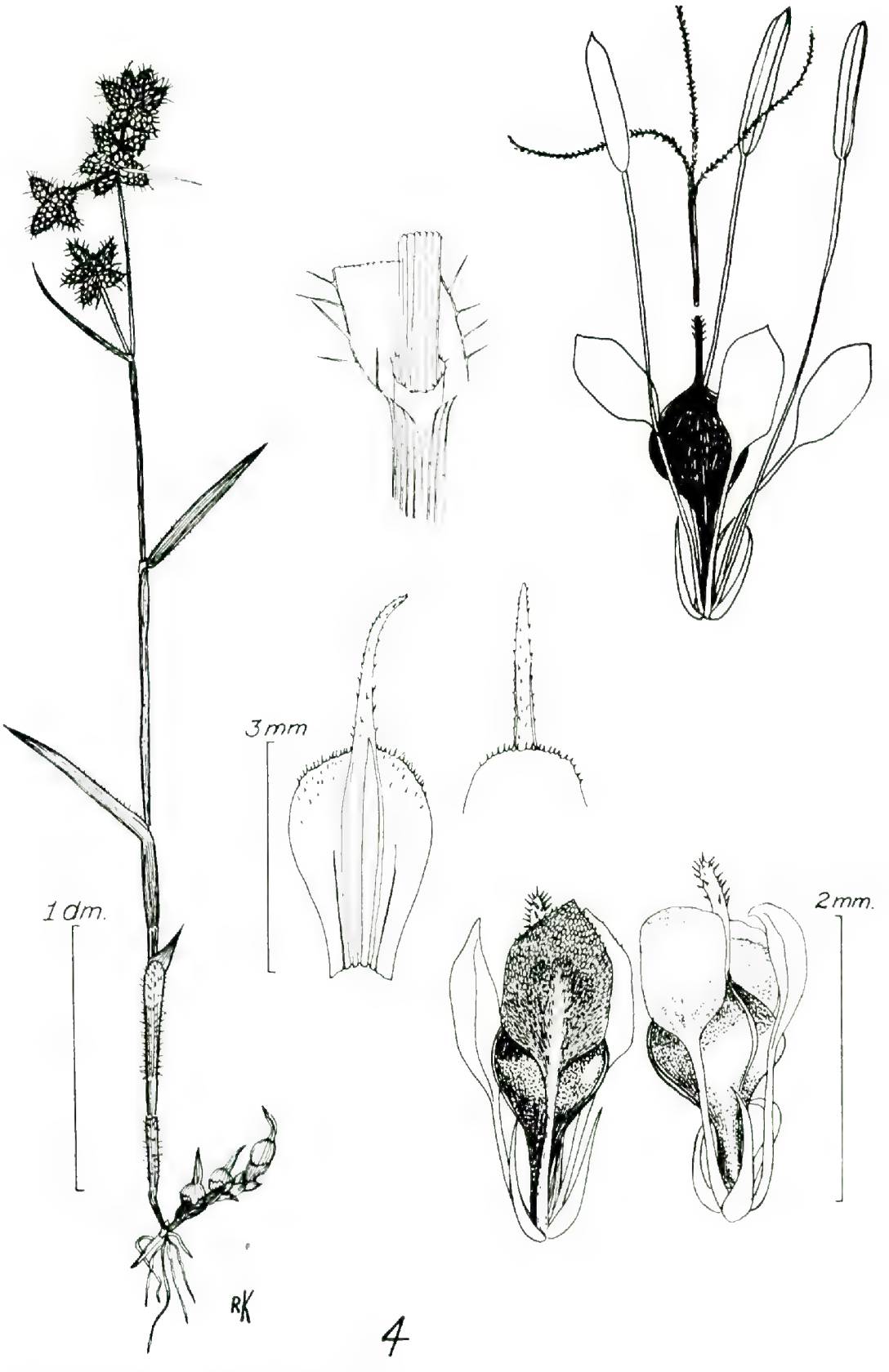


Fig. 4. *F. breviseta* (*Kral 38239*).

Fig. 5. *F. squarrosa* (*Kral 23225*).

offshoots. Culms to 1 m tall, usually lower, erect to ascending or leaning on other plants, culms strongly multicostate, smooth except in the inflorescence. Lowest leaves scaly, mostly sheath, blades progressively longer as mid-culm is approached, then gradually diminishing in size into the inflorescence; sheaths cylindrical or gradually inflated distally, strongly multicostate, hispid-hirsute, sometimes also hirsutulous (in a few extremes with uppermost sheaths or a culm nearly smooth); leaf blades spreading to erect, linear-attenuate, the larger mostly 8—20 cm long, 4—10 mm broad, mostly tapering from near the clasping base to the apex, strongly margined, upper surface scabro-puberulent and finely nerved, lower surface puberulent and hispid-hirsute, strongly raised-nerved, the margin spreading hispid-hirsute; ligule short-cylindric, ciliate, oblique, scarious. Systems of glomerules in a rather dense terminal cluster, often also from the next lower 1—2 nodes on stiffly erect or ascending, angulate, hirsute or hirsutulous penduncles. Glomerules subcapitate, spikelets crowded, digitately spreading, the clusters subtended by leaf-like bracts, 1 usually longer than the cluster subtended. Spikes ovoid to cylindric-lance-ovoid, to 2 cm long. Fertile scales obovate, 2.5—3.5 mm long, rounded or retuse, ciliate, with reddish or greenish-brown sides and a pale green or tan midzone, longitudinal ribs 3 (—5) medially, the central strongest, all merging into a scabro-hispidulous, spreading-recurved mucro more than ½ as long as the scale body. Florets 2.0—3.5 mm long, perianth 6-parted, calyx bristles reaching at least to the base, often to the middle of the petal blades, antrorsely barbellate. Corolla scales long-stipitate, claws slightly shorter than to nearly as long as the blades, blades narrowly to broadly ovate, usually incurved-acuminate, frequently minutely prickly apically on the inner face, bases cordate, truncate, broadly cuneate or abruptly attenuate, dorsal surface with a strongly raised longitudinal rib continuous with the scale apex and with at least 1 pair of spreading lateral nerves; scale body either of a consistent thickness or distally tumid. Anthers 3, ca. 1.0 mm long. Stipe of akene shorter than the petal claws; akene with 3 edges pale, wirelike, faces lustrous, deep brown or castaneous, faintly cross-lined. Fig. 5.

Open bogs, shores, ditches, seeps and wet peaty clearings, usually on substrates derived from sands, sandy alluvium, siliceous rock or shales, U.S.A. from Long Island southward in the Coastal Plain to peninsular Florida and west into eastern Texas; inland throughout the Piedmont and contiguous portions of the southern Appalachians and into the Mississippi embayment north to southern Arkansas and western Tennessee. Map 2.

Type: "Georgia": Presumably collected by A. Michaux. Holotype: P, material from Florida, Mississippi and Louisiana compared with holotype by Dr. Lourteig matches well.

To the north of its range in the Atlantic Coastal Plain are forms which are quite tumid in the distal 1/2—1/3 of the petal blade. This characteristic shows up less frequently southward in the Coastal Plain and inland, is quite

rare even in southern Alabama populations, and is not found west, where all *F. squarrosa* populations have flatter, frequently more slender petal blades. The elongate, retrorsely barbellate calyx bristles appear to be quite constant in character throughout the range of the species. This same taxon is sometimes parametered so as to include *F. pumila*, which is annual, has anthers but 1/2 as long as those of *F. squarrosa*, and which has tumid, slenderly pointed petal blades as well as much longer calyx bristles. Neither is this to be confused with *F. bushii* (*F. ciliata* B. F. Bush), a southwestern Coastal Plain species which is often taller, has anthers about twice as long as those of *F. squarrosa*, and which has a characteristically longer-ciliate leaf margin together with conspicuously longer awns of the fertile scales. The petal blades of this last are at maturity much more swollen even than the N.J. extremes of *F. squarrosa*.

6. FUIRENA **bushii** Kral, nom. nov.

F. ciliata Bush, Mo. Bot. Gard. Rep. 16:91. 1905.
not Leprieur ex Steud., Syn. Pl. 2:126. 1855.

Rhizome elongate, slender, with rather distant cormous offshoots. Culms 1-several, sometimes appearing tufted, erect to leaning on other vegetation, to 10 dm tall, subterete to angled, multicostate, proximally smoothish, distally hirsute. Lowest leaves scale-like, mostly sheath; medial culm-leaves largest, sheaths mostly overlapping on the culms, strongly hirsute, multicostate, cylindrical, rather loosely investing the culm, ligule scarious, reddish-brown, erect, oblique, ciliate with long hairs; leaf blades linear, spreading to ascending, the largest 6—15 (—20) cm long, 5—10 mm broad, tapering from the rounded-clasping base to the attenuate apex, upper surface sparsely to copiously strigose-pilose, lower surface heavily so, margins incrassate, stiffly spreading-long-ciliate. Upper culm leaves gradually reduced toward the inflorescence, more distant, sheaths not overlapping and culm exposed for longer intervals. Spikelets in tight clusters (in depauperate specimens peduncles may terminate in a single spikelet) on slender, angulate, stiffish, hirsute to hirsutulous primary and secondary peduncles, each cluster from one to several glomerules, some stalked, and arranged either terminally or also with additional clusters from the next lower 1—2 nodes, each cluster of glomerules substended by 1—3 involucral bracts similar to leaf blades but smaller, the longer ones often longer than the spikelet cluster. Fertile scales obovate, 3.0—3.5 mm long, greenish or reddish-brown, marginally subscarious, rounded or retuse, ciliate, backs hirsute and/or hirsutulous, medially strongly 3-nerved, these converging distally to form a spreading-recurved, stiffish, scabrid mucro nearly as long as the scale body. Fruiting florets ca. 2.0—2.5 mm long. Sepals smooth, usually extending to the base of the petal blades. Petal claws often fully 1/2 the total length, blade above the base of the akene body; blades ovate, basally rounded, cordate or short-attenuate, flattish and triple-nerved, distally

becoming very tumid, often subterete and terminating in a short-conic apex, apiculate, smooth or with a slight scabrosity adaxially distally. Anthers 3, ca. 2 mm long. Akene with stipe shorter than the petal claws, surfaces of the sharply trigonous body a lustrous pale to deep brown, angles wirelike, glassy, paler; stylar end sometimes nearly 1 mm long with a papillose-hispidulous apex. Fig. 6.

Acid, usually boggy or seep situations, generally in full sun in arenaceous soil districts, Coastal Plain and Interior Highlands, Louisiana westward into central Texas, northward into the Ozarks of Arkansas and Oklahoma. Map 1.

Type: Texas: Smith Co., swamps, Swan, *J. Reverchon 2911.* 10 Jun 1902, Holotype: MO; Isotypes: GH!, NY!

This species vegetatively and in character of petals is closest to *F. squarrosa.* In Louisiana and in east Texas the two are sometimes found in the same bog. As is true of some other sedge complexes where closely related species may occupy what seems to be the same habitat and not intergrade, these two appear not to hybridize.

7. FUIRENA SIMPLEX Vahl, Eclog. 2:8. 1798.

F. obtusiflora Vahl, Eclog. 2:8. 1798.
F. schiedeana Kunth, Enum. Pl. 2:183. 1837.
F. squarrosa var. *macrostachya* Britt., Bull. Torrey Bot. Club 11:87. 1884.
F. cylindrica Bush, Mo. Bot. Gard. Rep. 16:91. 1905.
F. zacapana Bartlett in Rob. & Bartl. Proc. Am. Acad. 43:50. 1907.
F. primiera M.E. Jones, Contr. W. Bot. 18:25. 1933.

Perennial, to 1 m tall, usually 2—4 dm, from stout and short to long and slender rhizomes, without axillary cormous offshoots. Shoots erect to ascending or leaning on other plants, tufted or lined out along the rhizome, internodes terete to somewhat angled, multicostate, usually smooth except toward the upper culm. Leaf sheaths somewhat inflated, multicostate, those of mid-culm usually smooth, those of upper and lower culm hispid or hirsute; ligule short-cylindric, oblique, membranaceous, pale brown, ciliate; leaf blades linear or lance-linear, larger ones from 5—20 cm long, 3—7 mm broad, spreading or ascending to erect, usually tapering gradually from the clasping base to the attenuated apex, the margin usually hispid ciliate, the upper surface smooth to pilose, the lower surface hispid, pilose, or smooth. Spikelet clusters grading from solitary and terminal to 2—3 (—5), the lower or hirsutulous, slender, slightly spreading or erect, axillary peduncles and all subtended by 1—3, narrowly linear bracts similar to leaf blades, the longest longer than the subtended spikelet cluster. Spikelets ovoid, lance-ovoid or cylindrical, 0.8—1.5 (—2.0) cm long, usually acute. Fertile scales with body mostly obovate or oblong, 2.5—3.5 mm long, thinnish, usually tan with tints or maroon and green, or olivaceous, rounded or slightly emarginate, ciliate, the back scaberulous, puberulent, hispid or

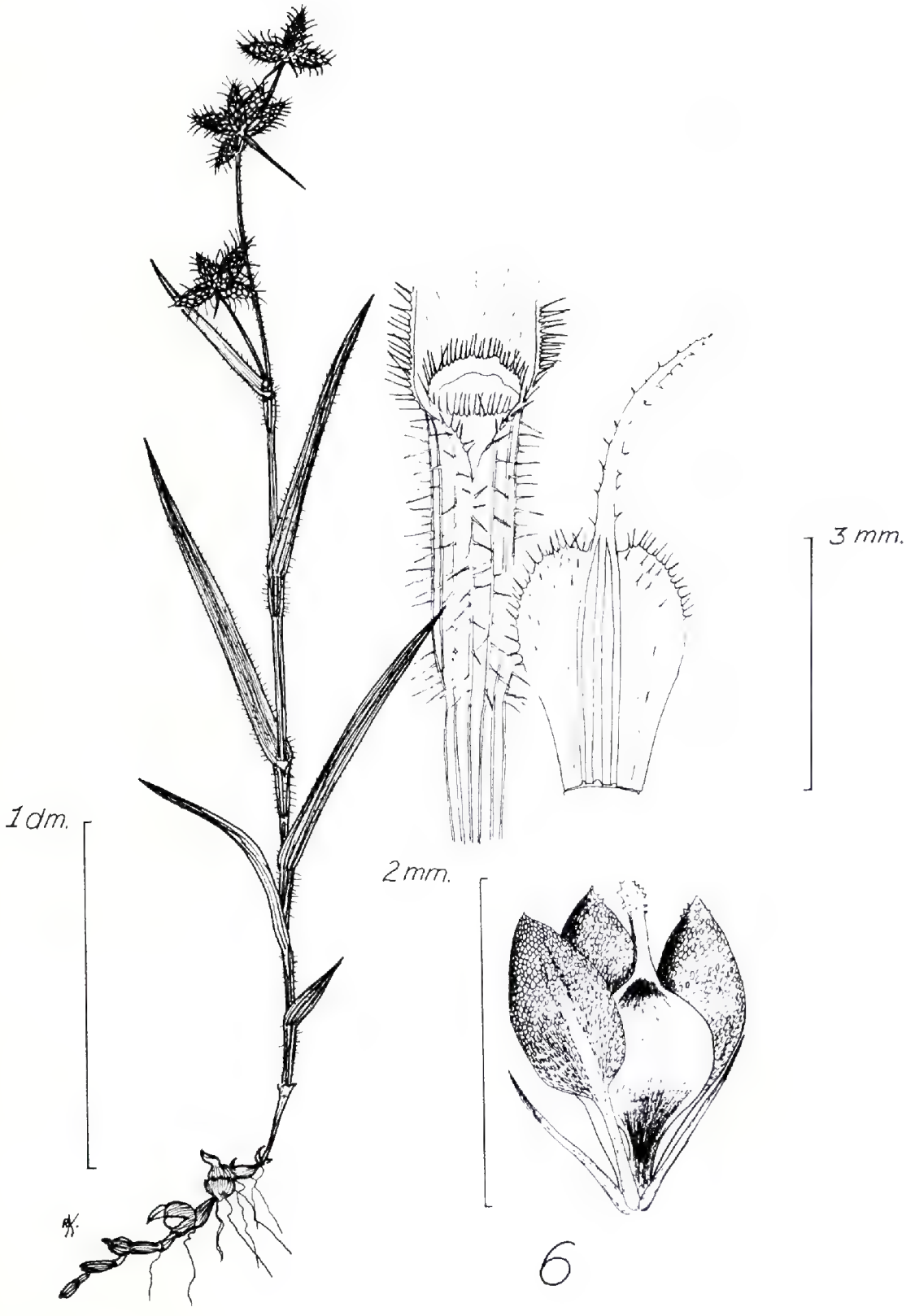


Fig. 6. *F. bushii* (*Kral 24477*).

nearly smooth, usually the lowermost scales of a spikelet with the longest and most abundant hairs; scale back medially with 5—7 strong, raised nerves, 3 strongest convergent to form a stiffish but spreading, usually scabrid, pale green mucro, usually 2/3 or more the length of the scale. Florets mostly 2—3 mm long (exclusive of bristle tips), calyx bristles reaching at least to the bases of the petal scales, retrorsely barbellate, sometimes with narrow blades (i.e. *Marsh 1740*, Monclova, Coahuila, Mexico). Petal blades longer or shorter than their slender claws, mostly ovate with apices acute to rounded or retuse, margins sometimes bristly distally, bases attenuate or truncate, cordate, rounded; bases of petal blades usually flattish except for 3 raised nerves and the thickened margin but distally usually tumid, with the mid-nerve dorsally and subapically excurrent as a short to elongate, erect or incurved mucro. Anthers usually 3, mainly from 0.9—1.2 mm long. Akene prominently stipitate, angles wire-like, glassy, usually pale, faces flat to slightly concave or convex, a deep, glossy brown, reddish-brown or even yellowish; stylar apex narrow, usually papillose-tipped. Fig. 7.

Sunny swamps, swales, bogs, seeps, ditches and wet places, America from southern Kansas and Illinois southward through the Interior Highlands and plains of the U.S. into Texas, New Mexico, thence southward through Mexico (incl. Baja California) into Nicaragua; in the Caribbean in Cuba, Jamaica, Puerto Rico. Venezuela? Map 1, 3.

This is perhaps the most variable in perianth of all American *Fuirena*.

Type: Jamaica: "Bocachica, *V. Rohr 27*". "American meridionali". Holotype: C! The type specimen shows only the leafy culm and the spikelets, but these are ample, the perianth unmistakable.

The common form of the species has 3 calyx bristles and 3 bladed petals but there are individuals throughout the range that produce a third set of very short bristles just inward on the receptacle from the calyx bristles. The calyx bristles are always retrorsely hispidulous or barbellate, their length varying but usually longer than the petal claws. The blade of the petal varies over most the range of the species. In the United States, at least through the Ozark system southwest through Texas, these are usually deltoid or ovoid, triple-nerved and cordate-truncate basally, becoming thickened toward the tumid apex, there somewhat emarginate and with a prominent, subapical-dorsal extension of the mid-nerve, this strongly projecting and retrorsely barbellate. Such plants are consistently perennial, strongly rhizomatous, usually tallish, and agree the most with material from most of Mexico and Central America. To the west in the United States and rarely in northern Mexico is a low, mostly e-rhizomatous, mostly annual

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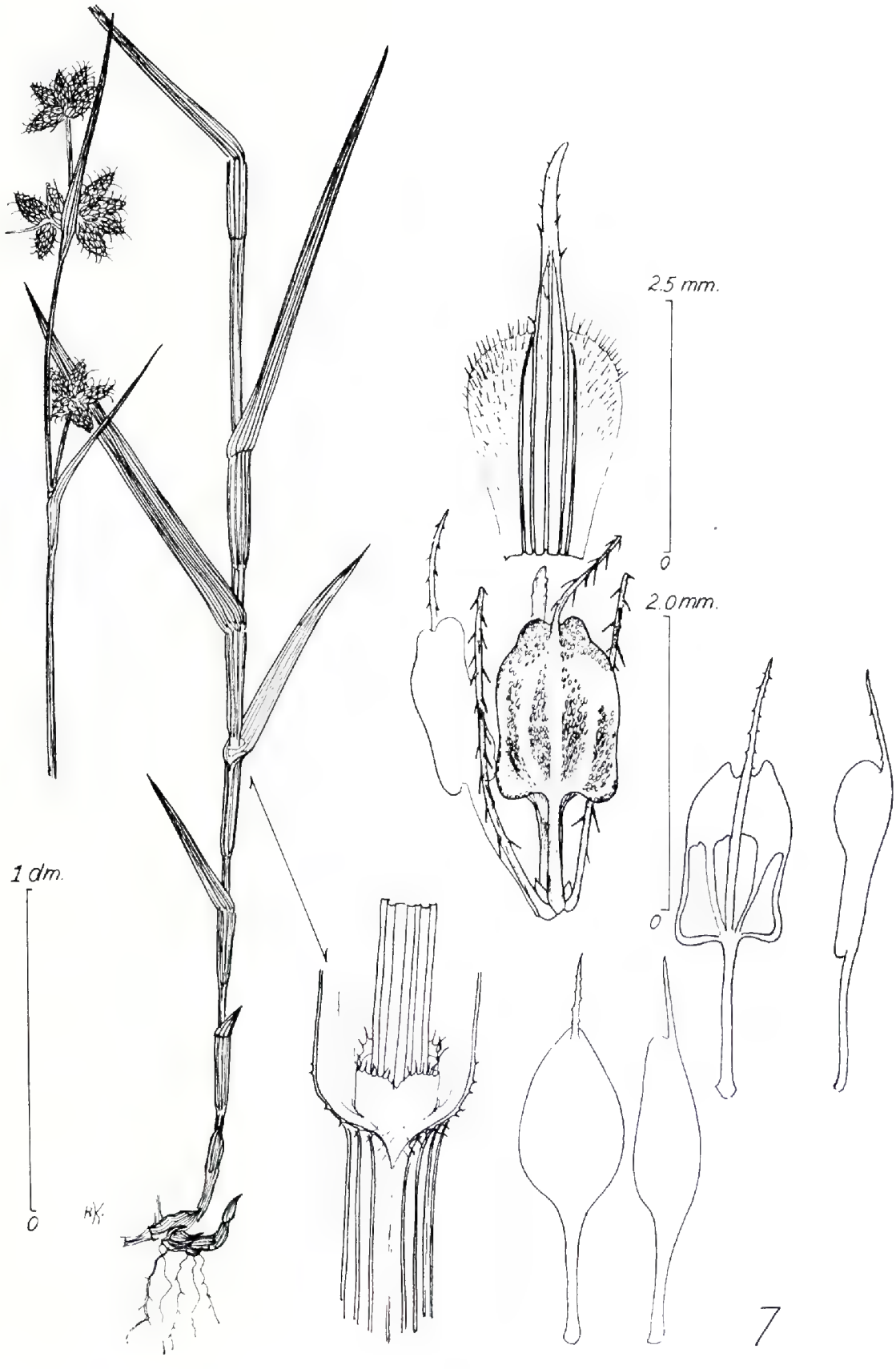
Fig. 7. *F. simplex* (plant habit from *Demaree 61188A*) fertile scale and floret just below from *Demaree 61188A*; perianth scales at mid-right from *York 46180*; perianth scales at lower right from *Kral 25288*).


1 dm.
0
2.5 mm.
0
2.0 mm.
0
7

plant with anthers 1/2 as long which appears to be a distinct geographical variant, here treated as var. *aristulata* (Torr.). Other variants showing slight perianth anomalies but otherwise blending well into the matrix of forms of this quite variable species, have been described as species, to wit: (1.) *F. zacapana* Bartlett. Guatemala: Swamp, Gualan, *C. C. Deam 423*, 13 Jan 1905 (GH! F!). (2.) *F. primiera* Jones. Mexico: Baja California. Primiera Agua, near Loreto, 19 Oct 1930, *M. E. Jones 27604* (POM! NY! UC!)

Some of the examples of Latin American *F. simplex* that give the most trouble are the ones which have the tumid petal scale apex projecting conically and at the same time have a very reduced subapical bristle. These must often be examined through all stages of their development in order properly to be sure of identification.

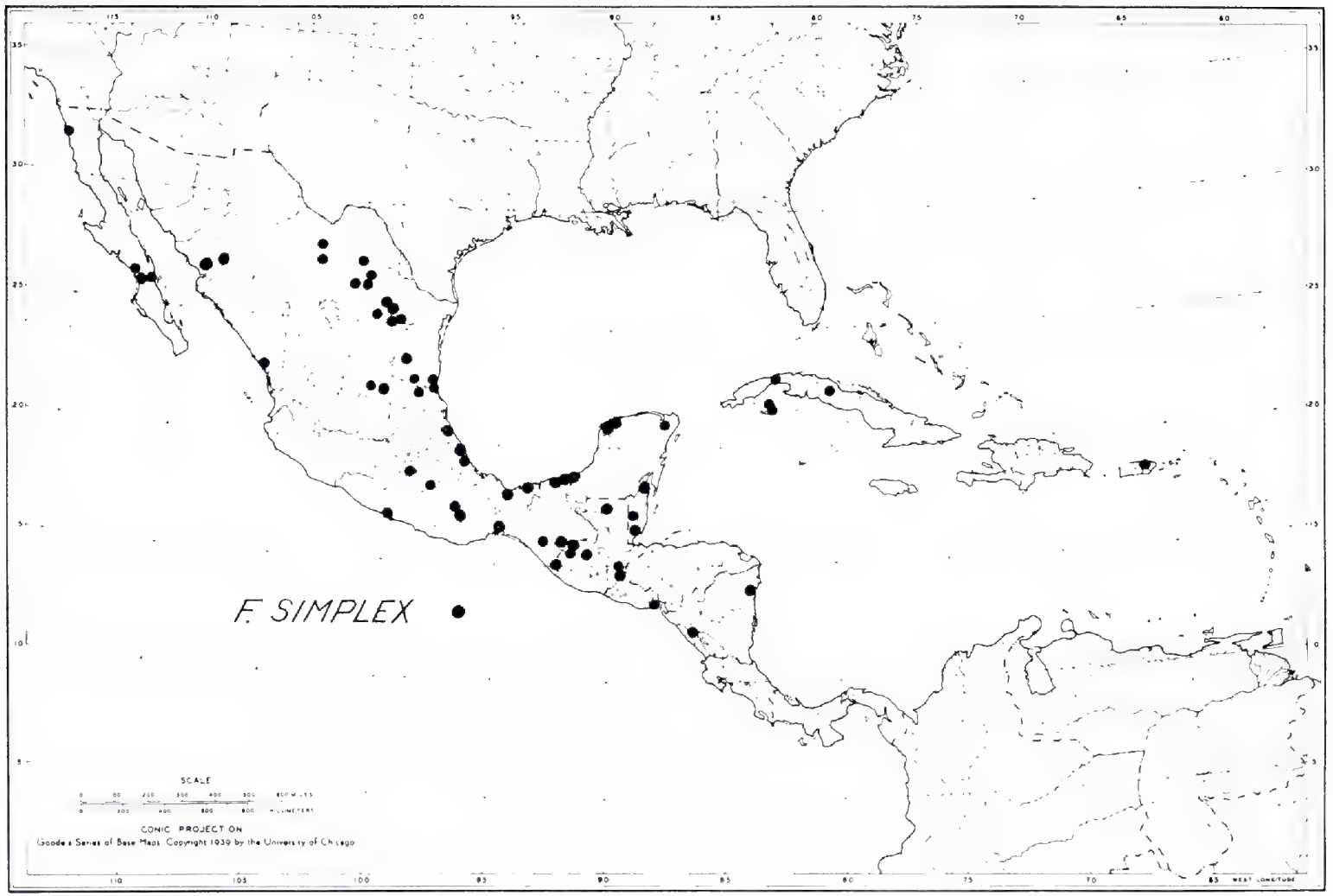
Sea-coastal races and those from brackish marshes inland show a tendency to produce the most extensively creeping rhizomes, often develop clones of gigantic size. Such plants are also smoother, shorter and harder-leaved, stiffer in habit.

7a. *FUIRENA SIMPLEX* var. **aristulata** (Torr.) Kral, comb. nov.

F. squarrosa var. *aristulata* Torr., Ann. Lyc. Nat. Hist. N.Y. 3:291. 1836.

Mostly annual, mostly without rhizomes, the slender culms single or in small tufts, erect or spreading, rarely taller than 3 dm. Lowest leaves mostly sheathing and bladeless or with mucro-like blades, smooth to sparsely hispid or hispidulous. Larger leaf blades ascending or spreading, lance-linear, 10 cm or less, attenuate, the margins hispid-ciliate at least proximally, the surfaces smooth to hispid or hispidulous, particularly along the costae; sheaths multicostate, terete or angled, smooth to sparsely or copiously hispidulous. Both sheaths and blades becoming progressively more pubescent upward on the culm. Upper portion of culm leafless, multicostate, usually hirsutulous. Spikelets in 1—3 clusters per culm, usually the terminal largest, the lower on slender, erect or ascending hispidulous peduncles, at least the uppermost cluster subtended by 1—3 linear-subulate bracts, these spreading or reflexed, 1 usually longer than the cluster. Spikelets mostly lance-ovoid, ca. 1 cm long or less, acute. Fertile scales with body obovate, rounded, 4.0—4.5 mm long, puberulent, brownish-green or olivaceous, mid-nerves 3, strongly raised, converging to a spreading or squarrose but stiffish, scaberulous or hispidulous mucro fully 2 mm long. Perianth 6-parted, the calyx bristles 1—2 mm long, retrorsely scabrid, the bladed members ca. 1.5 mm long with blades longer than the claws, oblong or ovate, truncate or retuse, flattish or distally tumid, the awn slightly subapical, dorsal, erect, very short to nearly 1 mm long and itself retrorsely barbellate; nerves of scale 3, the laterals arcuate. Stamens 1—3, the anthers mostly 0.5—0.6 mm long. Akene stipitate-trigonous, including the stylar end 1.5—1.7 mm long, the body broadly elliptic in outline, the angles prominent, wire-

Map 3.


CARIBBEAN AMERICA
No. 113
F. SIMPLEX
SCALE
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like, the faces flattish and glassy, usually pale brown or near white, the narrow stylar end smoothish or apically papillate, ca. 0.5 mm long. Fig. 7a.

Sandy or sandy-peaty low places in prairies, river and stream bottoms and seeps, Nebraska (mostly in the Platte and Loup systems) southward through Kansas and northwestern Missouri through Oklahoma and Texas. Rare and local in northern Mexico; New Mexico. Map 1,3.

Type: "Arkansas"? Long's Expedition to the Rocky Mountains, coll. by Dr. James. Holotype: NY, but Coville (1890) cites this, together with material I have on loan, to wit: New Mexico, *A. Fendler 877*; Texas: Comal Co., New Braunfels, *F. Lindheimer 185, 186*; Comanche Springs, *F. Lindheimer 206, 1244.*

One might question the advisability of retaining this as a distinct variety, particularly in context of a species as variable as *F. simplex*. My reasons are that this taxon appears to occupy a definite geographic area and is rather consistently a lower, more slender, and almost always a tufted e-rhizomatus plant. Its anthers at maturity almost always range between 0.5—0.6 mm in length while those of the rest of *F. simplex* are mostly around 1 mm long. There are some anomalies, i.e. material from Oklahoma: Greer Co., *G.W. Stevens 1018.1*, 18 Jun 1913, which has rhizomes. Such plants are occasional in southern Kansas, Oklahoma, and in Texas. But this might be in keeping with a variety of comparatively recent derivation from *F. simplex*. I hope to be able to study the chromosomes of this, essentially prairie plant, in order to see if there are real genomal differences.

8. FUIRENA PUMILA (Torr.) Spreng., Syst. Veg. I: 237. 1825.

F. squarrosa var. *pumila* Torr., Fl. N. & Midl. States I: 68. 1824.
F. torreyana Beck, Bot. U.S. 429. 1833.

Caespitose annual 0.8—6.0 dm tall, mostly 3 dm or lower. Culms erect or spreading, stiffish, but slender, the internodes multicostate, lower ones smoothish, the upper toward and in the inflorescence hispid. Lower leaves mostly sheath, those toward mid-culm with sheaths loosely cylindrical, smoothish to hispid, somewhat dilated distally, there with a pale to reddish-brown, thin, oblique, ciliate, ligule; blades spreading or ascending, linear-lanceolate or linear, mostly 5—12 cm long, 3—5 mm broad, mainly tapering from near the clasping base to the narrowly acute apex, margin somewhat cartilaginous-thickened, usually spreading-hispid or scabrid, surfaces strigose-hispid or smooth, multicostate beneath. Leaf blades thence somewhat reduced into the inflorescence, topping longer internodes, and usually hispid. Inflorescence a terminal cluster of spikelets, leafy-bracted, and often with pedunculate similar clusters from the next-lowest 1—2 nodes (in depauperate specimens the culm may produce but 1 spikelet!). Spikelets ovoid or ovoid-cylindric, mostly 0.7—1.5 cm long, the lowest bracts hairiest, often quite hispid or hispidulous. Fertile scales with bodies mostly obovate, ca. 3 mm long, rounded or slightly emarginate, ciliate, then, mostly greenish-brown,

backs rounded, hirsute, hispidulous or hispid, with usually 3 strongly raised nerves medially, converging to a strong, stiffish but slender and spreading-recurved mucro, nearly as long as the scale body and scabrid. Perianth of 6 members, calyx bristles retrorsely barbellate, extending at least to the base of the petal scales and often to near their tips. Petal blades long-clawed, mostly ovate, slenderly incurved-acuminate into apical bristles, the base rounded cordate or truncate, body thin and 3—5-nerved basally but

Fig. 7a. *F. simplex* var. *aristulata* (*McGrath 6016*).

medially and distally thickened. Anthers 0.5—0.7 mm long. Fruit stipitate, body trigonous, edges wirelike and pallid, faces a deep, lustrous brown or reddish-brown; apiculus narrow, somewhat papillose and thickened distally. Fig. 8.

Moist to wet, usually sandy or sandy peaty places, sometimes weedy, toward the coast from Massachusetts southward through the Coastal Plain to southern peninsular Florida, west in the Gulf Coastal Plain, but increasingly infrequent, to southern Texas with a disjunction inland in the Great Lakes lowlands of Michigan and Indiana. Map. 2.

Type: New York: Long Island, *J.R. Torrey*. Holotype: NY!; Isotype: GH!

Many have considered this as being but an annual variety of *F. squarrosa*, explaining that that species becomes annual north in its range. However, *F. pumila* has the same annual habit however far south it grows (and is annual in the greenhouse as well!), has a consistently different petal blade character, has consistently smaller, shorter anthers, and never produces the cormous rhizome buds as in *F. squarrosa*.

The nomenclature of the species has been a bit clouded because of the reluctance of some authors to cite the basionym. Thus the species has often been credited to Sprengel, though he himself made it plain that the name originated with Torrey.

9. FUIRENA UMBELLATA Rottb., Descr. & Ic. 70. 1773.

F. paniculata L.f., Suppl. 105. 1781.
F. tereticulmis Presl, Rel. Haenk. 1:180. 1828.
Scirpus umbellatus (Rottb.) O. Ktze., Rev. Gen. 3(2):337. 1898.

Perennial, the thick, scaly, fibrous-internoded rhizomes producing cormous offshoots. Culms stiffly erect or leaning, 5—11 dm tall, internodes multicostate and terete or frequently sharply 3—5-angled, toward the stout base (1.0—1.5 cm thick), smoothish or becoming hirsute or hispid at or toward the inflorescence. Leaf sheaths longest and overlapping at or near culm base, loosely investing the internode, cylindric, multicostate, smooth to hirtellous or hispid, particularly toward or at the inflorescence level; ligular orifice thin, brownish, erect, oblique, short-ciliate; blades short, scale-like at culm base, becoming longest at mid-culm or above, there linear-lanceolate, linear-oblong, 10—30 cm long, 0.8—2.5 cm broad, narrowly acute to attenuate, the margins smooth or scaberulous, the base clasping, upper surface smooth to sparsely or finely hispid, strigose, or scaberulous, finely and evenly nerved, lower surface smooth or variously hairy, strongly multicostate, the nerves often hispid. Leaf blades gradually reduced in size into the inflorescence, this a compound of distant to approximate clusters of sessile and pedunculate glomerules of spikelets, the lowest clusters on slender, elongate, usually hispidulous primary peduncles, the whole structure interruptedly cylindric and each cluster of glomerules subtended by

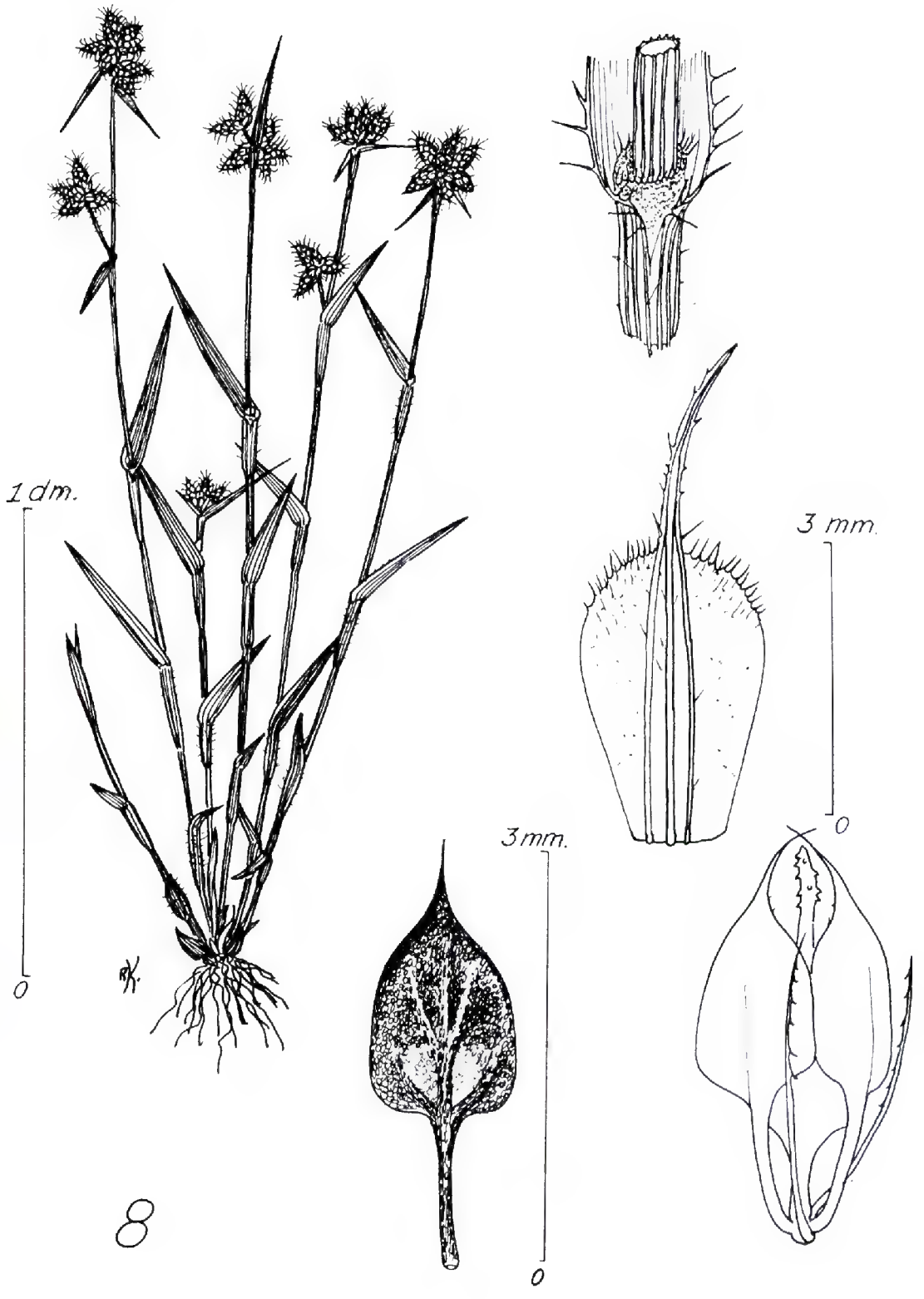


Fig. 8. *F. pumila* (*Kral 44735*).

1—3 leaflike hairy bracts, the longest longer than the cluster. Spikelets lance-ovoid or cylindrical, 5—8 (—10) mm long. Fertile scales oblong to obovate, 2.5—3.0 mm long, rounded or retuse, distally ciliate, thin, the backs greenish-brown, smooth to puberulent or strigillose, medially 3-nerved, these converging to a subapical, stiffish, flattish or subterete, ascending to spreading, scabrid mucro ca. 1/3 as long as the scale body. Florets 2.0—2.5 mm long. Perianth of but 3 scales (petals) the blades on crimped claws, short-oblong or obovate, 1.5—2.0 mm long, obtuse, rounded or emarginate, incurved-aristate, the arista often coiled apically, the blade body 3—5-nerved, thinnish. Stamens 2 or 3, anthers 0.7—1.0 mm long. Akenes 1.0—1.5 mm long, body angles wirelike, paler than the brownish, shining faces; apiculus apically papillose or smooth. Fig. 9.

Swamps, bogs, seeps, marshes and low, wet meadows, throughout the warmer, more humid parts of mainland Latin America and in the Caribbean. Old World tropics. Map 4.

Type: Surinam, *Rolander*. Not examined. The plate (from Rottb., Tab. XVIII. Fig. 3) shows a very good rendition of the slender, long arista on the petal scales, this unmistakably identifying the species.

10. FUIRENA CAMPTOTRICHA C. Wright in Sauv., Anal. Acad. Si. Habana 8:32. 1871.

F. bulbipes Blake, Contribs. U.S. Nat. Herb. 24:2. 1922.
F. umbellata var. *unguiculata* Kukenth., Report. Sp. Nov. 23:200. 1926.

In rhizome, culm, leaf, and generally in habit much like *F. umbellata*. Leaf blades mostly 5—20 cm long, 0.5—1.5 cm broad, usually spreading hispid-ciliate at least toward the bases, the ligular sheath-orifice short-ciliate, sometimes also strigillose. Inflorescence somewhat sparser, often more open. Spikes ovate to lance-ovoid or cylindrical, mostly 0.5—1.0 cm long, reddish or greenish-brown. Fertile scales as in *F. umbellata* with mucro seldom more than 1/3 the scale body length, erect or slightly spreading. Florets as in *F. umbellata*, the perianth scales on crinkled stipes, but the distal ½ of the blade tumid, hispidulous, and with a shorter, subapical mucro or awn (this in a few cases very minute or absent). Fig. 10.

Bogs, swamps, wet sunny places, near the southern coasts of and in the Isthmus of Mexico, southward into Panama and South America; Cuba. Map 4.

Type: Cuba. Havana: en sabanas humedas cerca de Dayaniguas, Jurisdiccion de los Palacios, *C. Wright 3778*; GH!, NY! This material shows the short, slender, subapical awn on the petal scale, together with the tumid scale apex typical of the species.

As Svenson (1957) has commented, this is so close to *F. umbellata* in many respects that it well could have arisen from that more widespread species. It may well be that a world revision of the genus would reduce such as *F. camptotricha* to varietal rank. However, in perianth character

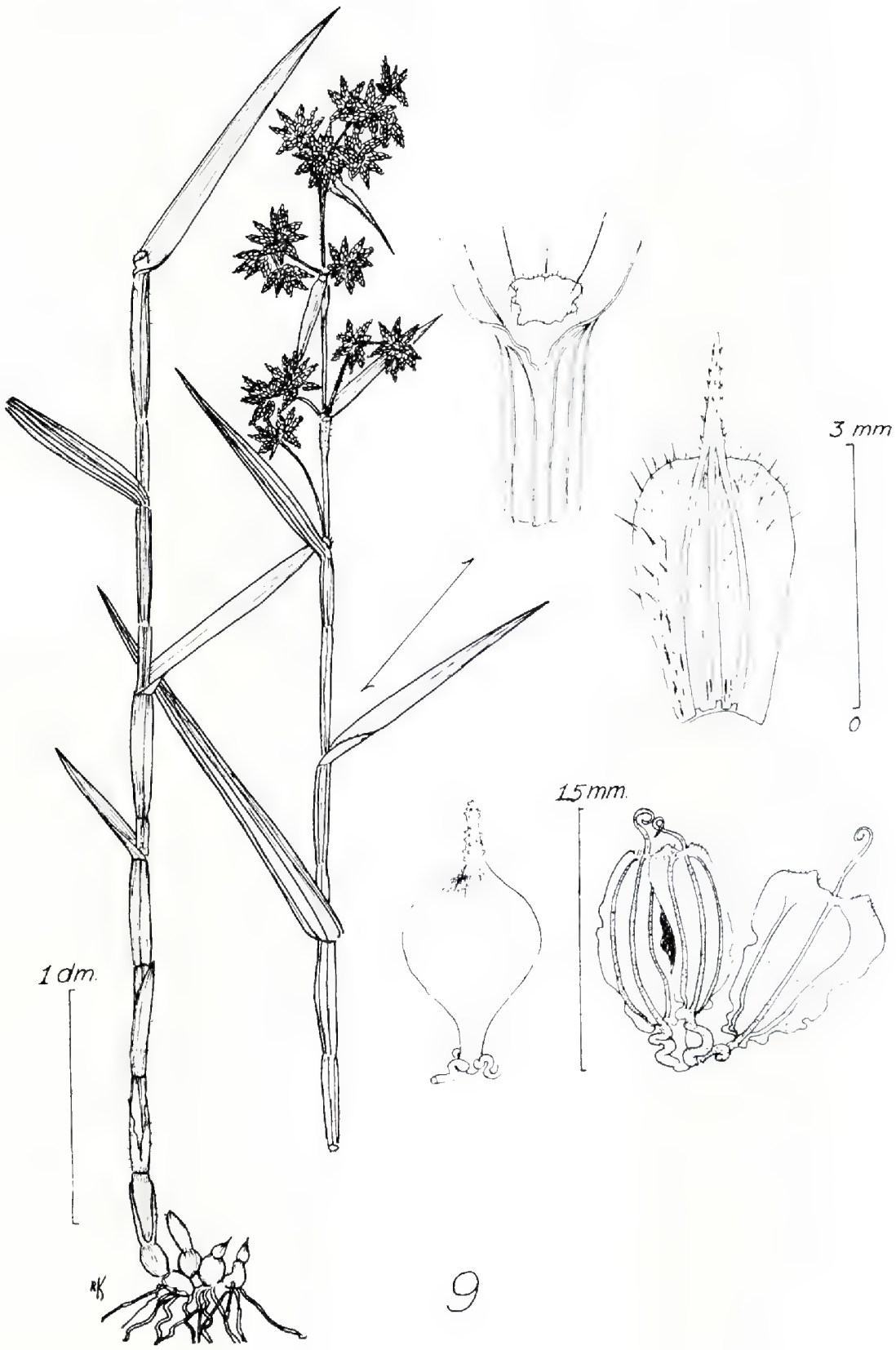


Fig. 9. *F. umbellata* (*Curtiss 299*).

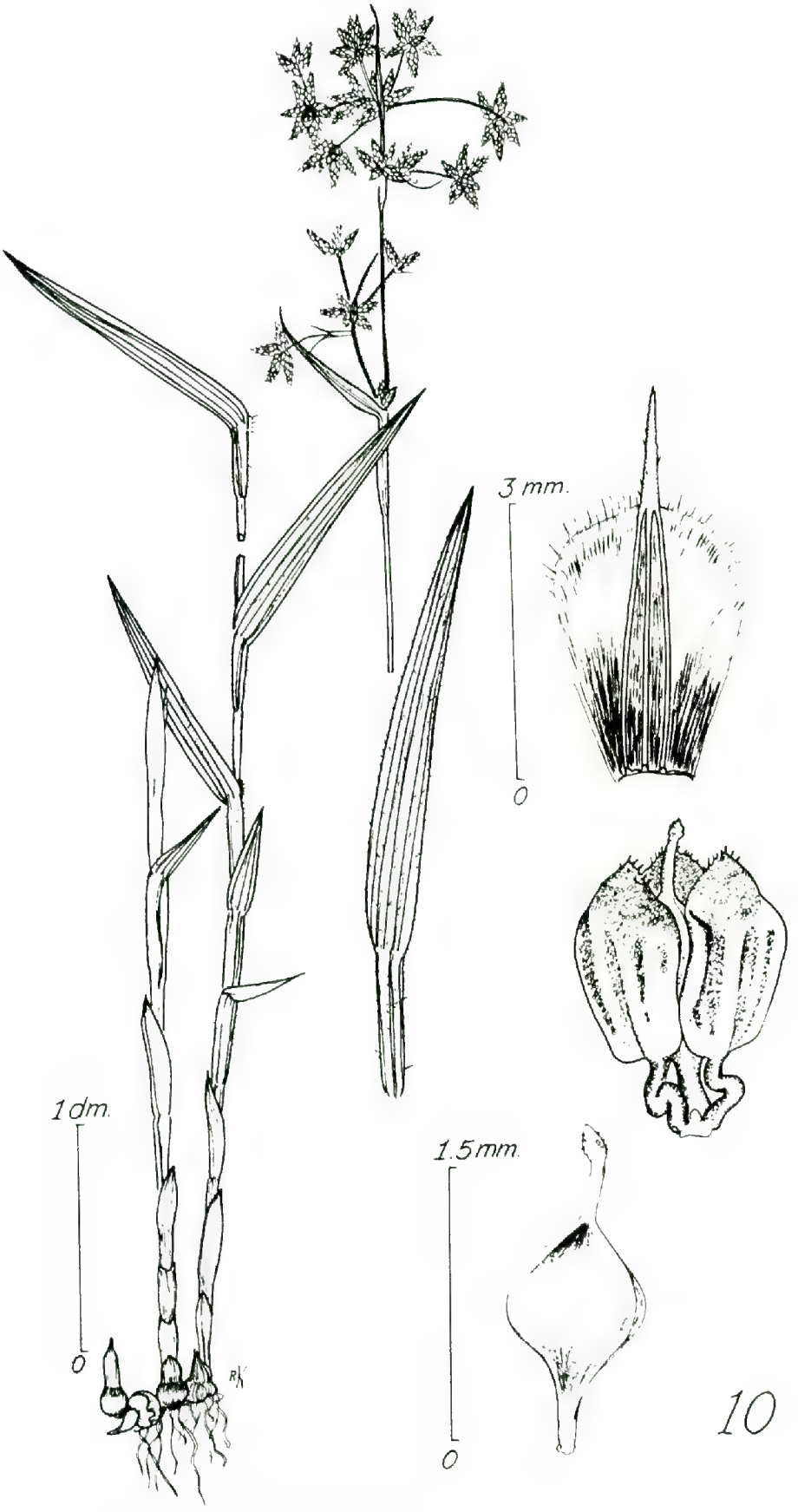
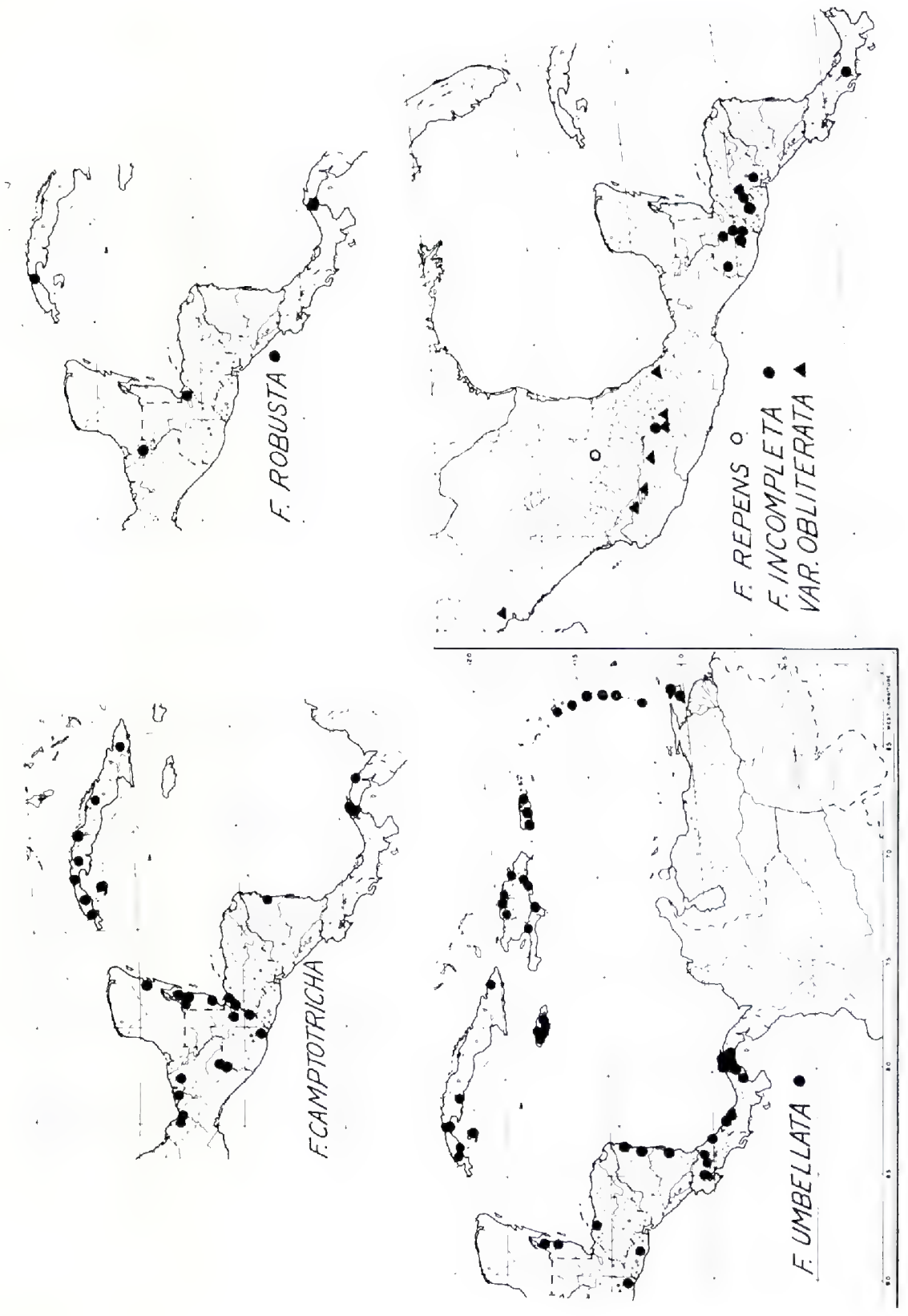


Fig. 10. *F. camptotricha* (*Kral 25066*).


F. ROBUSTA
F. REPENS
F. INCOMPLETA
VAR. OBLITERATA
F. CAMPTOTRICHA
F. UMBELLATA

Map 4.

it does show, with its subapical petal, bristle and tumid petal blade, some overlap with *F. simplex*, another species with which it is sympatric. Type material under the *C. Wright* number *3778* has been interpreted variously in that it also contains some *F. robusta*. But the Wright description on the one hand declares "setis nullis," thus eliminating *F. robusta*, and on the other includes the swollen perianth scale character, which eliminates *F. umbellata*, the species to which Svenson (1957) assigns the Wright specimens. A particularly bad specimen to interpret is *Nee* and *Mori 3636* from Colon, Panama, "0.7 mi NE of bridge over Rio Piedras on road from Portobelo to Pilon." This has petal blades crinkle-stiped, swollen distally and with a short subapical bristle as in *F. camptotricha*; on the other hand there are small bristles also, the base of the leaf blades are prominently and stiffly ciliated and the spikelet has larger dimensions, all characters of *F. robusta*. Such specimens (however rare) are an indication that the next phase of the study has to be an investigation of the cytology and breeding system in these *Fuirena*.

11. FUIRENA REPENS Boeckler, Bot. Jahrb. 7:277. 1886.

Slender low perennial, the rhizomes creeping, slender but swollen at irregular intervals into narrowly fusiform thickened zones, pale reddish-brown, internodes frequently 2 cm long, often forking or 3-branched or producing compact, narrowly fusiform, several-noded rhizomatous offshoots, these developing apically into leafy shoots. Shoots erect, low, rarely reaching 2.5 dm, the lowermost part scaly, smoothest, the leaves of midculm longest; sheaths tubular-cylindric, rather loosely investing the culms and often overlapping, multicostate, hirsute, the ligular orifice scarious, oblique, long-ciliate, pale brown; larger leaf blades narrowly linear, ascending or spreading, to 5 cm long, rarely broader than 5 mm, attenuate from near the base to the slender apex, smooth to sparsely or copiously hirsute, sparingly spreading ciliate proximally. Culm smooth proximally multicostate, with internodes becoming spreading hirsute upward, terminating in a subcapitate cluster of (1-) 3—7 spikelets subtended by 1—3 leaflike bracts, these shorter than to twice the length of the spikelets, spreading, hispid-hirsute proximally, smooth to scabrid distally. Spikelets lance-ovoid, greenish or olivaceous, the longest ca. 1.0 cm long. Fertile scales obovate, thin, ca. 2.5 mm long, the backs hispidulous and sparingly strigose, medially 3-nerved, these converging to form a spreading-ascending mucro to 1.5 mm long. Perianth with calyx bristles reduced to minute sharp-tipped tubercles; petals ca. 2.0—2.5 mm long, the claw ca. 0.4 mm long, the blade ovate, proximally flattish and triple-nerved, the distal ½ inflated and tapering into a slender, erect to incurved awn. Anthers ca. 2 mm long. Akene ca. 1.5 mm long altogether, the stipe shorter than to nearly as long as the sharply trigonous body, the stylar end slender elongate, slightly broadening and scaberulous-papillose distally; akene surface pale, minutely cancellate-punctate, the 3 edges smooth, wirelike, glassy. Fig. 11; map 4.

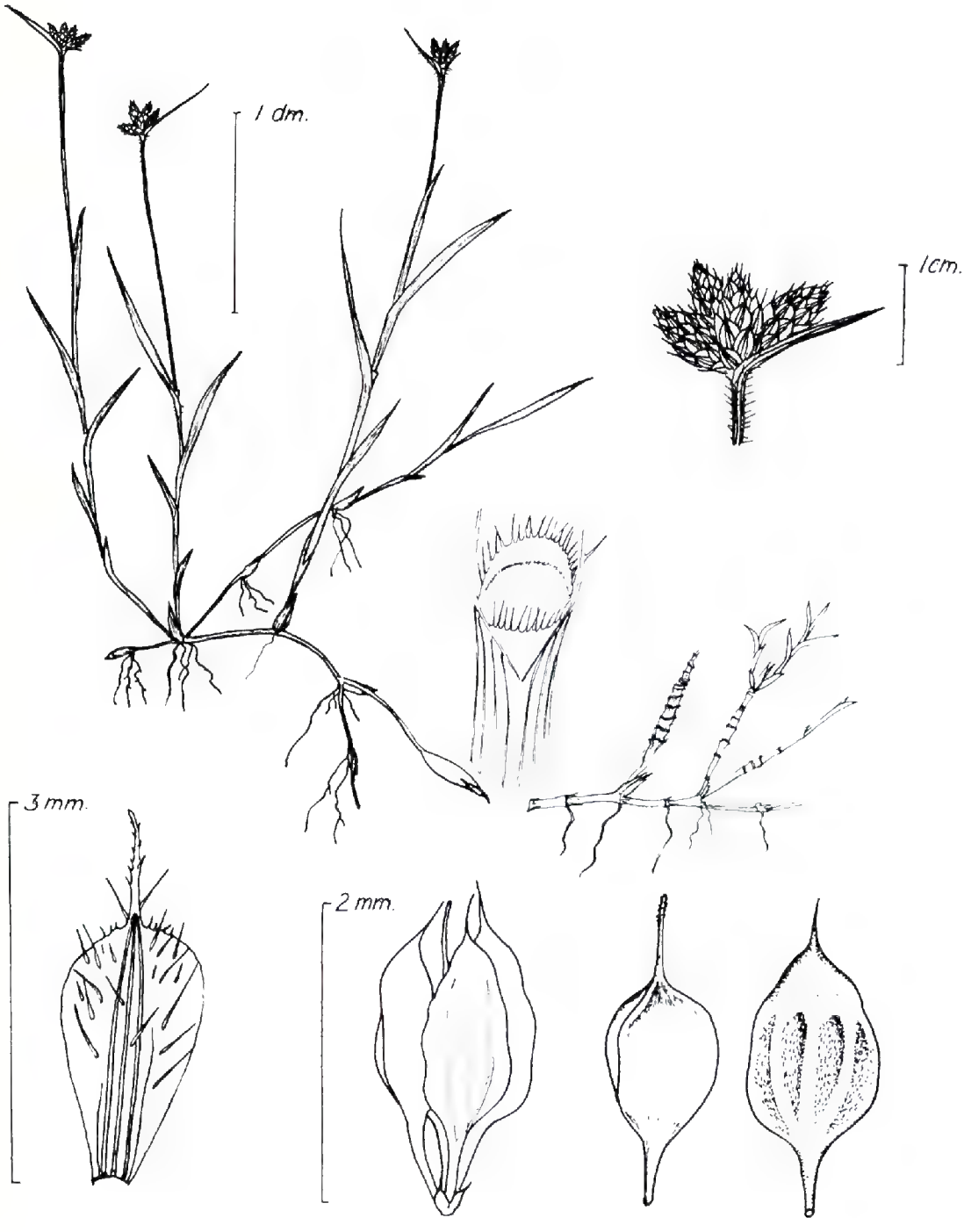


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Fig. 11. *F. repens* (*Schaffner 196*).

Type: Mexico: San Luis Potosi: "San Louis Potosi, leg. *J.G. Schaffner 196*, 1879. Herbarium V. A. Vigener." Holotype presumably at Berlin and destroyed. Neotype: NY!; isoneotype: C!

This species, so far as I know, has only been collected from its original locality, and only two numbers, both collections of J.G. Schaffner are extant. I have designated the specimen at NY as the neotype. The label of *J.G. Schaffner 567* (GH! PH!) adds somewhat to the sparse information about the species, namely: "in paludosis, San Rafael, ex convalli San Luis Potosi."

Admittedly, there is little information on which to base retention of this as a species. However, it differs from the others in so many respects as to deserve reconsideration. Hopefully the plant will be refound.

12. FUIRENA INCOMPLETA Nees in Mar., Fl. Braz. 2(1):107. 1842.

F. hexachaeta Schlecht. Linnaea 19:69. 1847.
Scirpus incompletus (Nees in Mart.) T. Koyama, Journ. Fac. Sci. Univ. Tokyo, III, 7:287. 1958.

Perennial 4—14 dm tall, from creeping rhizomes, the culms erect, ascending or leaning on other vegetation, nearly caespitose or set closely together in lines. Internodes usually smooth except in the inflorescence, usually sharply 3-angled. Lowest leaves mostly sheathing and bladeless or with short-triangular blades, usually smooth or puberulent, mid-culm leaves with sheaths loosely enfolding internodes, mostly sharply 3-angled, smooth to puberulent or hispid, the ligular orifice very short-cylindrical, oblique, scarious, reddish-brown, smooth to hispidulous; leaf blades at mid-culm longest, linear, mostly tapering gradually from base to apex, 4—17 cm long, 4—7 mm broad, the edges smooth and cartilaginous thickened, sometimes remotely ciliate proximally, the surfaces smooth or strigillose along the nerves beneath, particularly along the strongly raised median. Inflorescence with central axis usually hispidulous, either a single terminal cymose compound of glomerules of spikelets, or a series of 2—4, well-separate compound of glomerules, the lowest usually on short to elongate, slender, erect to slightly divergent primary peduncles, these densely hispidulous, sharply 3-angled (sometimes the spikelets of clusters tending to be compactly pinnately disposed!). All clusters of glomerules subtended by leaflike bracts, the lowermost longest, usually equal to or longer than the subtended spikelet cluster, then gradually shorter, grading to smaller ones subtending individual glomerules, thence to the lowermost fertile scales. Spikelets narrowly oblong-cylindric to lance-linear, 0.7—1.4 cm long, usually acute. Fertile scale body broadly elliptic, oblong, or obovate, 3.0—3.5 mm long, rounded, short-ciliate or nearly entire, very thin, the backs mostly greenish-brown or olivaceous, rounded, appressed-puberulent or hispidulous, usually with 3 greenish, slightly to strongly raised median nerves convergent to an erect or slightly spreading mucro ½ as long to nearly as long as the scale body and strigillose. Perianth of 4—6 subequal, retrorsely barbellate

Fig. 12a. *F. incompleta* (*Killip 4573*).

bristles, these extending to or exceeding the style tip of the akene. Anthers mostly 3, 0.8—1.5 mm long. Akene short-stipitate, 1.5—2.0 mm long, the body trigonous, broadly or narrowly rhombic in outline, angles prominent and wirelike, faces concave or flattish, lustrous brown or greenish-brown, stylar apiculus short, distally papillose. Fig. 12.

Marshes, bogs, seeps, usually in full sun and at elevations of 5000 ft. or more in the mountains, Mexico southward into southern South America. Map 4.

Type: Brazil: Sta. Maria. Goyaz, *Pohl.* The type specimen has not been examined by this writer, but the description leaves no doubt. Two varieties are distinguished by Nees, mainly based on pubescence character. The variety "alpha," according to Nees is pubescent, the sheath angles hirsute-ciliate, the leaves puberulent above, hirsute beneath. The variety "beta" is, for the most part, smooth. Material I have seen from north of South America all appears to fit the former variety.

Toward the north of the range of the species, in Mexico from the state of Mexico north and west to Sonora in the Sierra Madre Occidental, a geographical variant appears which merits description, namely:

12a. FUIRENA INCOMPLETA var. **obliterata** Kral, var. nov.

F. incompleta Nees var. *alpha* affinis, a qua imprimis differt perianthii absenti vel vestigiali, setis redactis inaequalibus achenii stipite breviore vel parum longiore.

Similar to the var. "alpha" of *F. incompleta* but from which it differs particularly by the perianth absent or vestigial, with the reduced bristles unequal, shorter than to slightly longer than the stipe of the akene. Fig. 12b.

While this variety overlaps *F. incompleta* proper in the state of Mexico, it is the sole representative of the species northward. It appears from the type description of *F. hexachaeta* Schlecht., that it does not vary significantly in any way from that rendered for the species *F. incompleta* by Nees ab Esenbeck.

Known localities for the new variety are as follows: Type: Mexico: State of Mexico: north end of Tenancingo; large seep near Tenancingo Park by Mex. hwy. 55, *R. Kral 25234*, 30 Jul 1965. Holotype: US!; Isotypes to be distributed. Other records: Mexico: Jalisco State: Sierra del Tigre 3 mi S Mazamitla, *R. McVaugh & W. N. Koelz 410* (MICH); sandy clay of seepage by Mex. hwy. 15, 17.3 mi E Guadalajara, el. 5000′, *R. Kral 25622*. Mexico State: Temascaltepec, Penon, 1700 meters, *Hinton 4406*. Nayarit State: rocky sloping oak savanna, el. ca. 4000′, 9.5 mi WNW Chapallilla by Mex. hwy. 15, *R. Kral & J. Murrell 27555*; seepage area in red sandy clay soil, oak type with scattered pine, between Chapallilla and Ixtlan beside Mex. hwy. 15, *R. Kral 25648*. Sonora State: Tepopa, Rio Mayo, rooted in mud of springside, *H.S. Gentry 1412* (F, GH, MICH, UC). Map 4.

1. FUIRENA WALLICHIANA Kunth, Enum. Pl. II. 182. 1837.

Below is a description based solely on a collection made by Dr. Clyde F. Reed, seemingly from a chance (temporary?) introduction appearing

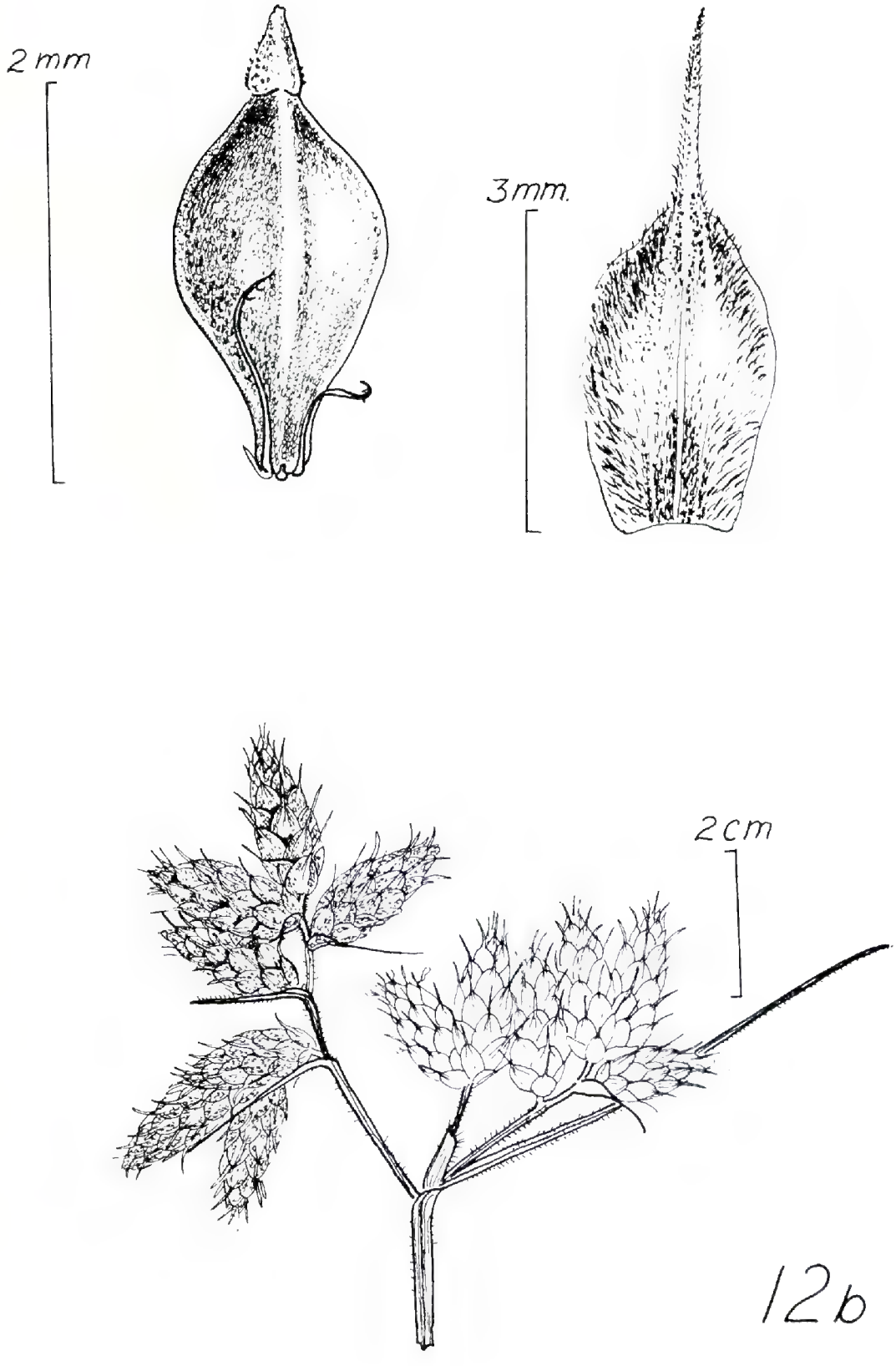

Fig. 12b. *F. incompleta* var. *obliterata* (*Gentry 1312*).

in "wet areas of chrome ore piles" in Newport News, Warwick County, Virginia. The collection, deposited at PH, is described as follows.

Perennial to 5 cm tall, smoothish, culms tufted, close-set along branched, thickish, scaly rhizomes. Internodes smooth, strongly few-costate, slender, longest toward the inflorescence. Sheaths tubular, slightly dilated around the shoot, the lowest lacking blades, oblique, scarious-margined, converging to small cusps. Sheaths at mid and upper culm shorter, their orifices bearing an oblique, scarious, low-ciliate, short-cylindric ligule. Largest blades toward mid-culm or above, these 5—10 mm long, narrowly linear, no wider than 3 mm, gradually attenuated from near the blade base, smooth except for the scabrid, slightly involuted, margin, the lower surface rather strongly costate and with a prominently raised mid-rib. Inflorescence either a single terminal spikelet or an inequilaterally arranged cymose system of spikelets, usually few, digitately spreading or in some cases spreading pinnately along secondary peduncles, the spikelet clusters usually subtended by a linear-filiform-bladed bract, this longer than the cluster; all peduncles angulate, scabrid. Spikelets lance-ovoid or lance-cylindric, acute, ca. 0.7—1.0 cm long, greenish brown. Fertile scales ovate or oblong, ca. 3 mm long, thin, appressed-puberulent, bearing medially 3 rather indistinct nerves converging to a slender, smoothish or papillate-scabrid, pale green, erect to slightly spreading mucro ½ or more as long as the body. Perianth bristles 2—6, of various lengths, often geniculate, sometimes distantly and irregularly pinnately few-branched, even somewhat webbed between the branches on largest bristles, the branches and axis tips marginally long-papillate. Anthers 3, ca. 2 mm long. Fruit trigonous, ca. 1.5 mm long, ellipsoidal in outline, the stipe short, the angles sharp, pale papillate-serrulate, the faces convex, strongly cancellate, the stylar apiculus short-triangular, pale, papillate. Fig. 13.

The webbing between the sparse branches of the petal bristles approaches the description of *F. coerulescens* Steud., but the habit of the plant, the character of its fertile bracts, the tendency for the bristles to be shorter and the strongly cancellate akene faces suggest *F. wallichiana* Kunth, a species of the East Indies. This particular material is interesting in that it shows a transition between a species such as *F. incompleta* whose perianth is entirely of bristles and those which show the conventional *Fuirena* perianth comprised at least in part of bladed members. Certainly one sample alone is not basis enough for identification, particularly in that the specimen comes from a very extreme habitat.

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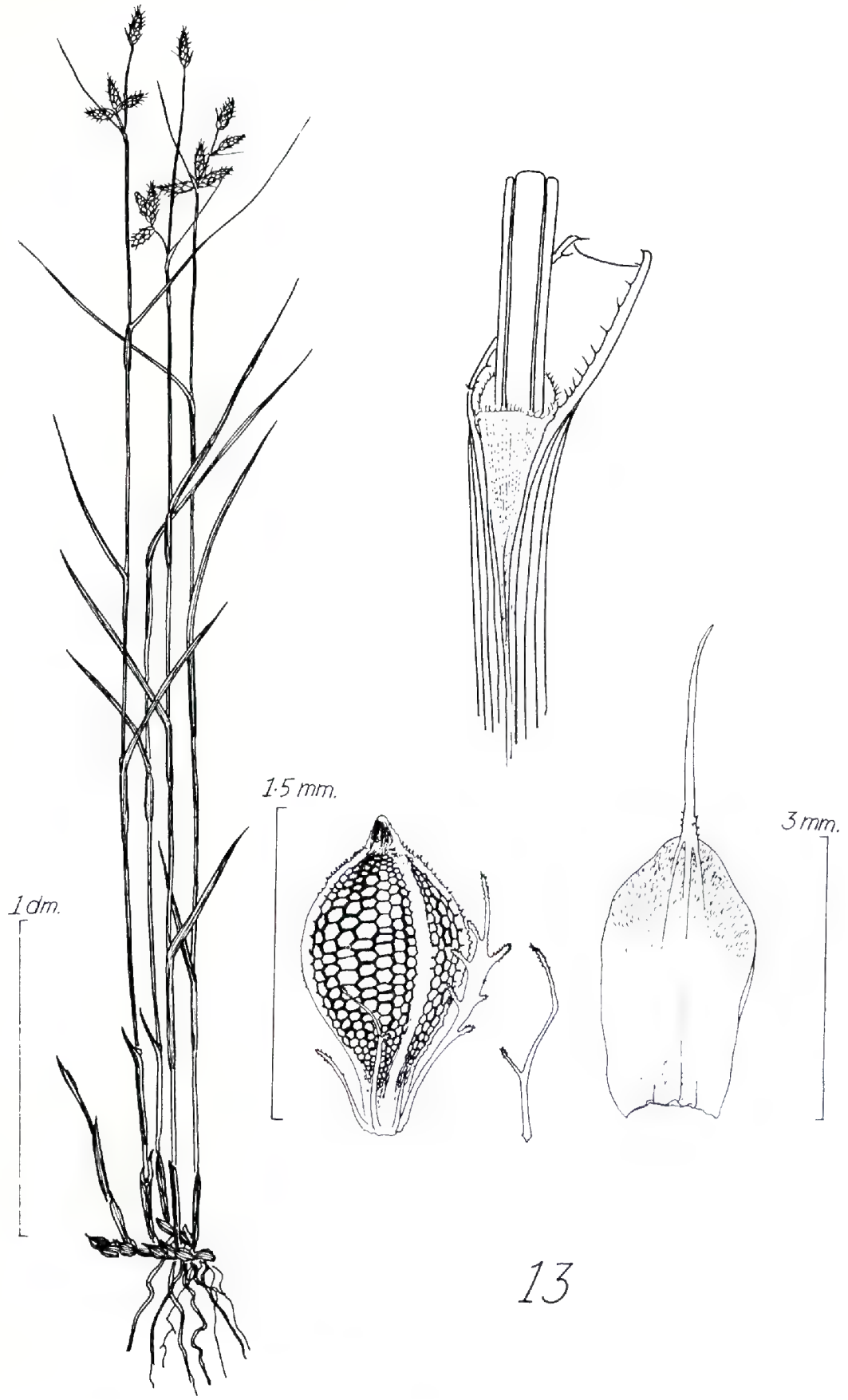

Fig. 13. *F. wallichiana (Reed 44066).*

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A REVISED DESCRIPTION OF THE SALT MARSH RUSH, JUNCUS ROEMERIANUS.

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ABSTRACT

A reevaluation of nine taxonomic characteristics presently used to identify *Juncus roemerianus*, in view of recent morphological, populational and distributional information, indicates that existing descriptions are inadequate or incorrect. A new description of the species is given.

INTRODUCTION

Juncus roemerianus Scheele is found only on the east coast of North America (Weimarck 1946, Eleuterius 1975), where it produces a copious vegetational cover over tidal marsh on the south Atlantic and Gulf Coasts of the United States (Eleuterius 1976a). During a recent autecological study of the species two distinct plant types were recognized based on flower morphology. One plant type was hermaphroditic, bearing perfect flowers and the other was female, bearing imperfect, pistillate flowers (Eleuterius and McDaniel 1974, Eleuterius 1974). The plants spread rapidly by means of vigorous rhizome growth and a single plant type may dominate several acres or more of tidal marsh (Eleuterius In review a). In view of these and other recent findings the biological characteristics presently used to identify and describe *J. roemerianus* need reevaluation and clarification. Manuals used to describe this plant have erroneous descriptions. The salient taxonomic features of the plant species have not been previously recognized, thus inadequate descriptions prevail. Although I have studied herbarium specimens of other members of the *Junci Thalassi* of which *Juncus roemerianus* is a member, I feel that this "classical" approach may perpetuate existing errors in the literature. This paper covers nine taxonomic features and the reasons for the needed change. A revised description of the tidal marsh rush is given.

Historical sketch. Scheele (1849) first described and named *Juncus roemerianus* from plants bearing flowers collected on Mustang Island at Galveston, Texas. Prior collections of the species from North America were considered *Juncus maritimus*, the European form named by Lamarck (1789). However, Chapman (1860) discovered an isolated colony of true *J. maritimus* on Long Island, New York. Later authorities such as Coville (1894) cite Chapman as the author of *J. maritimus*. Although Scheele discovered what he considered a new species, he did not describe the distinctive features of *J. roemerianus*. Engelmann (1861-1868) described the plant

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and pointed out some of the distinct characteristics which separate it from the closely allied *J. maritimus*. This separation was based primarily on seed morphology. He also stated that he found "a rare form of *J. roemerianus* where both circles of stamens were suppressed or rather underdeveloped and in a rudimentary state so that those plants became unisexual." He also noted that *J. roemerianus* was the only species of *Juncus* which produce unisexual plants. Corresponding male plants were not seen, but he suggested that they may exist. The specimens that he observed were from Georgia and Florida. Other early workers such as Coville (1894), Chapman (1897), Small (1903), and Blankinship (1903) listed *J. roemerianus* in their papers or manuals.

Breeding system. Chapman (1897) and Fernald (1950) stated that *Juncus roemerianus* was dioecious and Small (1903, 1933) suggested that the "flowers were usually dioecious." Radford et al. (1968), Correll and Johnston (1970), Correll and Correll (1975), Gleason (1968) and Jones (1975) considered the species to be hermaphroditic, having perfect flowers. However, Gleason (1968) stated that the stamens were "usually none in fertile flowers." Long and Lakela (1972) described the flowers as unisexual, but do not clarify their distribution. Thus, the species may be assumed to be monoecious or dioecious.

In recent work, only perfect and pistillate flowers have been found, although thousands of inflorescences of *Juncus roemerianus* have been examined (Eleuterius and McDaniel 1974). Collections were taken from Mississippi, Texas, Louisiana, Alabama, Florida, Georgia, South Carolina and North Carolina. Extensive study of the rhizomes during anthesis shows that they bear culms with inflorescences composed exclusively of pistillate or perfect flowers. A given rhizome produced only one flower type, never both. Transplanted clonal material from unisexual and bisexual plants have for five years consistently produced only the respective flower type (Eleuterius and McDaniel 1974, Eleuterius 1974, In review b). Plants grown from seed have also consistently produced a single flower type (Eleuterius, In review c).

I have also searched in vain for staminate flowers in plants comprising mature stands and in the progeny of known parental types from widely separated areas. Only plants with pistillate or perfect flowers are apparently produced. These data offer sufficient proof that the species is gynodioecious.

Involucral bract. The terminal bract is erect and terete and appears to be a continuation of the stem. Correll and Johnston (1970) and Correll and Correll (1975) state that the terminal bract is 3 times as long as the inflorescence. Observations of plants in various habitats indicate that this feature is unreliable as a taxonomic characteristic since the bract may range from 2—90 cm in length and may be from ½—10 times the length of the inflorescence.

Inflorescence morphology. Small (1903, 1933) described the culm as a scape, while Correll and Johnston (1970), Correll and Correll (1975) state that the inflorescence is a panicle, with compound branching, 7—12 cm in length. Buchenau (1906) described the inflorescence as a panicle, but did not indicate size. Gleason (1968) stated that inflorescence was 6—15 cm in length.

Recent work corroborates paniculate descriptions of the inflorescence; however, the form and size are extremely variable between populations (Eleuterius 1974). The inflorescence may vary from a few- to a many-branched panicle. The length of the inflorescence branches may vary, producing in some instances tufted inflorescences. The reason for this phenomenon is unknown. In most instances the inflorescence is loosely branched, but ranges from 2—45 cm in length. The variations within populations is relatively small; however, that between certain populations is considerable, differing by 100 orders of magnitude or more (Eleuterius, In review a). The cause of this variation is presently unclear, but under investigation.

Flower cluster. Correll and Johnston (1970) and Correll and Correll (1975) indicate that the flowers occur in clusters of 2—5. Gleason (1968) states that the sessile clusters occur in groups of 2—4, with two to six flowers in each. I find that the sessile clusters occur in groups of 2—6, with from 2—8 flowers per cluster. The solitary flowers referred to by Jones (1975) are obviously immature, since flower development occurs sequentially in each cluster (Eleuterius, 1974, 1975).

Bracteole. Eleuterius (1974), Gleason (1968) and Correll and Johnston (1970), Correll and Correll (1975) point out that each flower is subtended by a short, ovate bract. I have not observed any occasional extra bract mentioned in the latter two references cited above which may represent a feature peculiar to a localized population on the Texas coast.

Capsule. Descriptions of the capsule in the major taxonomic reference manuals are highly variable. This is understandable since the mature capsule of each flower type is distinctly different, a fact not recognized until recently (Eleuterius and McDaniel 1974). Certain populations produce inflorescences with occasional capsules containing 6—8 carpels, suggesting genetic aberration.

Seeds. Only Gleason (1968), Long and Lakela (1972), and Radford et al. (1968) present descriptions of the seeds, although they are obviously important in separating *Juncus roemerianus* from closely related species. Many seeds, especially from hermaphroditic plants, apparently do not reach maturity; these are undersized, transparent and have low viability. Since seed development is rapid, reaching maturity in 3—5 weeks (Eleuterius 1975), and each capsule encloses seeds in different stages of development, the difference, although slight, is sufficient to merit special attention in identification. The seeds may be elongate, wedge-shaped or round, generally not caudate, but often with a slight point at one end. Englemann (1861-

1868) stated that the only apparent difference between *J. roemerianus* and the European *Juncus maritimus* Lam. is the presence in the latter of a minute hooked appendage at one end of the seed. This is questionable and merits further study.

Plant form and size. Correll and Johnston (1970) and Correll and Correll (1975) state that *Juncus roemerianus* is a tufted perennial. Long and Lakela (1972) state that it occurs in large tufts with the culms spaced in rows on horizontal scaly rhizomes. While these statements are essentially true, *J. roemerianus* generally does not grow in tufts, like *Juncus effusus* L., because the erect shoots are widely separated by long rhizomes. The intershoot distance along the rhizomes of *J. effusus* is very short, producing a closely arranged, dense mass of erect shoots or tuft. The elongated, spreading rhizome of *J. roemerianus* is apparently unique among rushes (Eleuterius 1976b), especially in context of species found in dry ground or freshwater marshes. Although I have examined *Juncus gerardii L.* from New England, I have not examined adequate material of the European *J. maritimus* or the South American *J. acutus* var. *leopoldii* (Parlatore) Buchenau and other taxa inhabiting saline tidal marshes.

Small (1903, 1933), Correll and Johnston (1970), Gleason (1968) state that the height of *Juncus roemerianus* varies from 5—12, 5—15, 4—10 dm, respectively. Jones (1975), Long and Lakela (1972) and Radford et al. (1968) state that the species is 1, 1.5 and 0.5—1.5 m tall respectively. Mature plants (bearing flowers) have been collected ranging in height from 0.3—2.5 m. Plant height is generally uniform within a given stand, but very different between stands. The "average" height of *J. roemerianus* observed throughout the range of the species probably lies somewhere between 10.5—13.5 dm.

Period of anthesis. Correll and Johnston (1970) state that flowering occurs in the spring, while Long and Lakela (1972) state that it occurs in the fall. Radford et al. (1968) indicated that anthesis covers a period from May to October while Jones (1975) indicates the period extends from March to June. Direct observation on flowering over a wide range of habitats and through a number of years, study of herbarium collections and personal communication with a number of coastal researchers have provided adequate information to clarify the above inconsistencies. In North Carolina the species produces flowers from January to June, in extreme south Florida the species flowers during March and April, while in Mississippi it occurs from January to April. This longitudinal gradient suggests that the length of time that the plants are subjected to low temperatures (followed by increasing day length) is a critical factor influencing the duration of anthesis. The longer cold periods, apparently, correspond to longer periods of anthesis. The above reference indicating that flowering occurs in the fall is erroneous, although the dead culm with intact capsules may exist for a year or more (Eleuterius 1976b). When wet the empty capsules close. Plant workers less familiar with the species probably collected specimens with this persistent culm during the fall, thus, the irregularities.

The following revised taxonomic description summarizes the preceding subject discussions and presents other morphological details of value in identifying *Juncus roemerianus*.

JUNCUS ROEMERIANUS Scheele

Stout, rigid, densely spreading, gynodioecious perennial, with erect shoots 1.5—23.0 dm high; *leaves* all basal, terete, longer than the culm, the sheaths inflated with free margins, dark green with grey or brownish cast, auricles well developed to several mm high, cartilaginous; *culms* terete, pungent, less rigid than leaves; *involucral bract*, stout, spinescent, varying in length from a few cm to 3 dm or more, conspicuous, generally longer than the inflorescence, resembles leaf in cross-section; *inflorescence* paniculate, scape branches very unequal, 2—30 mm long; *flowers* perfect and pistillate on separate plants, 2—8 in small clusters, each flower subtended by bracteole; *perianth segments of perfect flowers* about 4 mm long, pale brown, glossy, indurate, the outer broadly lanceolate, obtuse to acutish, with a broad scarious margin, often subtended by a minute auricle, the inner tepals shorter, acute to obtuse at the scarious-margined apex; *stamens*, 6 nearly equaling the perianth, the anthers 1.5—2.5 mm long, about five times longer than stout filaments; *stigmas* yellow or light brown; *capsule* subglobose, obtuse, mucronate, 5 mm or less long, the valves rigid, equal or shorter than the perianth, *seeds from perfect flowers* obvoid, acute to slightly tailed at one end, finely reticulate to striate, pale yellow to light brown to brown, 0.3—0.6 mm; *perianth segments of pistillate flowers* same as above, except shorter, 3 mm long, reddish brown with a short staminoid at the base of each tepal, *stigmas* much exceeding the perianth, red; *capsule* about 5.5 mm long, much exceeding the perianth; *seeds from pistillate flowers* obvoid, acute to slightly tailed at one end, finely reticulate, brown to dark brown, 0.4—0.6 mm.

Tidal marshes from Delaware to south Florida and westward to Texas. Anthesis occurs from January to June in North Carolina, the period becoming shorter southward and restricted to March and April in extreme south Florida. Westward from northern Florida into Texas, anthesis occurs from January to April. Seeds are shed about four weeks after the flowers reach maturity.

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ADDITIONS TO THE VASCULAR FLORA OF OKLAHOMA

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ABSTRACT

Forty-seven new taxa are reported to the Oklahoma flora and specimens of four additional taxa are cited which verifies their present occurrence in the state. The fifty-one taxa are as follows: *Lycopodium adpressum, Potamogeton natans, Cenchrus echinatus, Panicum verrucosum, Eleocharis smallii, Eleocharis tortilis, Scirpus supinus, Rhynchospora gracilenta, Rhynchospora rariflora, Scleria muhlenbergii, Scleria verticillata, Carex decomposita, Carex leptalea, Carex Swanii, Wolffia punctata, Eriocaulon decangulare, Juncus capitatus, Melanthium virginicum, Burmannia capitata, Habenaria repens, Spiranthes odorata, Glinus radiatus, Paronychia Drummondii, Tillaea aquatica, Parnassia grandifolia, Aeschynomene indica, Amorpha paniculata, Colutea arborescens, Geranium dissectum, Polygala cruciata, Bowlesia incana, Eryngium integrifolium, Cynoctonum sessilifolium, Lysimachia quadriflora, Phlox paniculata, Scutellaria integrifolia, Linaria canadensis* var. *canadensis, Bacopa monnieri, Epifagus virginiana, Utricularia inflata, Utricularia subulata, Aster ptarmicoides, Cirsium muticum, Euthamia graminifolia, Euthamia leptocephala, Evax candida, Onopordum acanthium, Solidago arguta* var. *Boottii, Solidago flexicaulis, Solidago gigantea* var. *gigantea, Solidago patula* var. *strictula.*

The following taxa are thought to be newly reported to the Oklahoma flora. Four of these taxa are listed as occurring in the state by other sources, but no specimens were cited or no specimens can be located in Oklahoma herbaria. Further, they are not treated as occurring in our flora or they are treated as doubtful in the most recent manual (Waterfall, 1969). All specimens cited were collected by John and Connie Taylor unless otherwise indicated, and are deposited at the Southeastern Oklahoma State University Herbarium (DUR). Duplicates of most have been sent to SMU, NELU, VDB, and KANU.

Most of these species were collected from eight hillside bogs in Atoka, Choctaw, McCurtain, and Pushmataha counties in southeastern Oklahoma. These bogs have developed mainly on sandy formations of the old Gulf Coastal Plain. They form along the flanks of very small drainage systems near their upper ends, and some of them contain several feet of peat. The bogs range in size from about an acre to over 40 acres. They may be forested, but grasses, sedges, and other herbaceous species compose the vegetation of most of them. There are 20 of these bog habitats known to the authors in southeastern Oklahoma.

The remainder of the species were collected from various habitats throughout the state. Most of the taxa occur in the Gulf Coastal Plain area of Texas and represent extensions of their known range northward and westward into

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Oklahoma. We have relied on three manuals for nomenclature: Correll & Johnston, 1970; Correll & Correll, 1972; and Steyermark, 1963.

LYCOPODIUM ADPRESSUM (Chapm.) Lloyd & Underw. ATOKA CO.: edge of bog, 0.5 mi NW of Boehler, 26 Mar 1975, *J. & C. Taylor 18217*; and bog 0.5 mi SW of Boehler, 10 Jun 1976, *J. & C. Taylor 21709*. This species is very similar to *L. alopecuroides* and it has been treated as a variety of that species.

POTAMOGETON NATANS L. MCCURTAIN CO.: Yashaw Creek, 2.5 mi S of Broken Bow, 20 Jul 1976, *J. & C. Taylor 22750*; PUSHMATAHA CO.: small creek 2 mi SE of clayton and about 130 m W of US hwy. 271, 9 Aug 1976, *J. & C. Taylor 23047*. This species is listed for Choctaw Co., Oklahoma by Correll & Correll (1972) but we found no Oklahoma specimens in our state herbaria.

CENCHRUS ECHINATUS L. MCCURTAIN CO.: edge of blind lake along the Red River, 3.5 mi E and 8.5 mi S of Idabel, 2 Aug 1976, *J. & C. Taylor 22837*. This is a weedy species of the coastal plain.

PANICUM VERRUCOSUM Muhl. CHOCTAW CO.: wooded bog, 4 mi NE of Swink, 4 Sep 1975, *J. & C. Taylor 20445*. This species is similar to *P. brachyanthum* which grows in similar habitats, but can be differentiated from that species by its smaller spikelets and lack of pubescence. Both panicums are species of the southeastern United States.

ELEOCHARIS SMALLII Britt. CHOCTAW CO.: collected from a sandy well drained roadside 2 mi E of Hugo, 10 May 1969, *J. Askew 116*. The species was determined by Barney Lipscomb. It is a wide ranging species of the northeastern United States, west to Illinois and southern Missouri.

ELEOCHARIS TORTILIS (Link) Schult. ATOKA CO.: bog about 0.5 mi SW of Boehler, 10 Jun 1976, *J. & C. Taylor 21711*. This species was determined by Barney Lipscomb. It is another plant of the coastal plain area of the United States.

SCIRPUS SUPINUS L. var. HALLII (Gray) Gray. ATOKA CO.: edge of a shallow water filled sandy depression in an open forest, 0.25 mi S of Boehler, 23 May 1975, *J. & C. Taylor 18541*. The very small form of *Echinodorus tenellus* grew with this species along the edge of these depressions. Species was determined by Barney Lipscomb. *Scirpus saximontanus*, which also occurs in Oklahoma, has been treated as a second variety of this species of the coastal plain area.

RHYNCHOSPORA GRACILENTA Gray. CHOCTAW CO.: bog 11 mi NW of Hugo, 22 Aug 1976, *J. & C. Taylor and J. R. Wright 23235*. PUSHMATAHA CO.: bog 3 mi S and 7.5 mi W of Antlers, 23 Jul 1976, *J. & C. Taylor 22774*. This is a species of bogs and similar habitats of the coastal plain area of the United States.

RHYNCHOSPORA RARIFLORA (Michx.) Ell. ATOKA CO.: from a bog, 0.5 mi SW of Boehler, 10 Jun 1976, *J. & C. Taylor 21710*; PUSHMATAHA CO.: bog on the north side of the county road, 3 mi S and 7.5 mi W of Antlers,

23 Jul 1976, *J. & C. Taylor 22773*. The range and habitat is similar to the preceding species.

SCLERIA MUHLENBERGII Steud. ATOKA CO.: bog 0.5 mi NW of Boehler, 13 Aug 1976, *J. & C. Taylor 23202*; PUSHMATAHA CO.: bog 5.5 mi W of Antlers, 1 Sep 1976, *J. Taylor 23387*; CHOCTAW CO.: bog 11 mi N of Hugo, 22 Aug 1976, *J. & C. Taylor and J. R. Wright 23238*, and from a bog 11.5 mi NW of Hugo, 2 Oct 1976, *J. & C. Taylor 23803*. This distinctive member of the genus *Scleria* is another species of coastal plain bogs and similar habitats. In bogs of Atoka and Pushmataha counties, this species, the two *Rhynchosporas* above, and *Dulichium arundinaceum* grow in mixed stands.

SCLERIA VERTICILLATA Muhl. CHOCTAW CO.: bog 11 mi W of Hugo, 22 Aug 1976, *J. & C. Taylor and J. R. Wright 23236*. This coastal plain species is equally rare in Texas (Correll & Correll, 1972) and in Missouri (Steyermark, 1963), but seems to be most abundant in the coastal plain habitats throughout the eastern half of the United States.

CAREX DECOMPOSITA Muhl. ATOKA CO.: edge of a bog 0.5 mi NW of Boehler, 6 May 1975, *J. Taylor 18447*. At this location it grew in a few inches of standing water with *Hottonia inflata* and *Peplis diandra*. This relatively large *Carex* of the eastern United States is reported to be rare (Correll & Correll, 1972).

CAREX LEPTALEA Wahlen. ATOKA CO.: bog 0.5 mi SW of Boehler, 15 May 1976, *J. & C. Taylor 21305*; CHOCTAW CO.: bog 4 mi NE of Swink, 2 Aug 1976, *J. & C. Taylor 22879*. At the Atoka Co. location *C. leptalea* grew at the edge of clumps of *Osmunda cinnamomea, O. regalis, Lorinseria areolata* and *Onoclea sensibilis*. These four fern species occur in most of the bogs we have studied, the last two found as far west as Marshall County.

CAREX SWANII (Fern.) Mack. MCCURTAIN CO.: floodplain forest along the west fork of the Glover River, 0.5 mi W of Battiest, 16 May 1972, *J. & C. Taylor 10375*. This species was determined by Dr. David Castaner. Its habitat is moist forests of the northeastern United States.

WOLFFIA PUNCTATA Griseb. ATOKA CO.: open water of a bog 0.5 mi NW of Boehler, 1 Nov 1976, *J. & C. Taylor 23965*. It was found growing with *Azolla caroliniana, Limnobium spongia*, and species of *Lemna* and *Spirodelia*. Correll & Correll (1972) list McCurtain Co., Oklahoma as part of its range, but we found no Oklahoma specimens in state herbaria.

ERIOCAULON DECANGULARE L. PUSHMATAHA CO.: bog on the south side of a county road, 3 mi S and 7.5 mi W of Antlers, 7 Jul 1976, *J. & C. Taylor 22410*; and a bog 5.5 mi W of Antlers 22 Aug 1976, *J. & C. Taylor 23252*. At both of these locations it was found growing with the small, rare, and endangered *E. kornickianum*, and with *Peltandra virginica* and *Iris virginica*.

JUNCUS CAPITATUS Weigel. MCCURTAIN CO.: along the moist, sandy roadside, 0.5 mi S of Moon, 29 Apr 1975, *J. Taylor 18405*. Species determined by Barney Lipscomb. This small *Juncus* is an introduction from Europe. It is reported to be rare in Texas where it is infrequently collected.

MELANTHIUM VIRGINICUM L. CHOCTAW CO.: from a bog 11 mi NW of Hugo, 22 Aug 1976, *J. & C. Taylor and J. R. Wright 23213*. These plants were about 4 feet tall and grew with *Spartina pectinata, Verbena hastata,* and *Veronicastrum virginicum.*

BURMANNIA CAPITATA (Walt.) Mart. PUSHMATAHA CO.: in bog 5.5 mi W of Antlers, 1 Sep 1976, *J. Taylor 23390*. This species was growing among grasses and sedges with such species as *Selaginella apoda, Eriocaulon kornickianum,* and *Bartonia paniculata.*

HABENARIA REPENS Nutt. ATOKA CO.: bog at edge of beaver pond, 0.5 mi NW of Boehler, 26 Oct 1974; *J. & C. Taylor 17262*. This is a large bog orchid of the coastal plain area in the United States.

SPIRANTHES ODORATA Nutt. CHOCTAW CO.: bog 11.5 mi NW of Hugo, 2 Oct 1976, *J. & C. Taylor 23799*. Species determined by Dr. Larry Mcgrath. While treated as a variety of *S. cernua* by Correll (1950), Leur (1975) feels that this taxon should be considered a separate species.

GLINUS RADIATUS (R. & P.) Rohrb. MCCURTAIN CO.: Big Grassy Lake (presently being drained) 4.5 mi E, 3.4 mi S of Tom, 2 Aug 1976, *J. & C. Taylor 22871*. Species determined by Wm. F. Mahler.

PARONYCHIA DRUMMONDII T. & G. ATOKA CO.: in an open sandy upland forest 130 m from the Boehler intersection, 6 May 1975, *J. & C. Taylor 18437*. The soil at this location is derived from the Antlers Sand Formation, with a very light, sandy, topsoil. The forest is composed of widely spaced trees with *Quercus incana, Sassafras albidum,* and stands of *Vaccinium arboreum* being abundant. The vegetation of the open areas is sparse and composed mainly of low herbaceous species. This type of habitat is very common on the Antlers Sand Formation of Atoka, Choctaw, and Pushmataha Counties. Some of the species that grow with *P. drummondii* at the Atoka Co. location are as follows: *Selaginella riddellii, Triplasis purpurea, Aristolochia reticulata, A. serpentaria, Eriogonum multiflorum, Polygonella americana, Leoflingia squarrosa, Polanisia erosa, Crotonopsis linearis,* and *Penstemon murrayanus.*

TILLAEA AQUATICA L. ATOKA CO.: edge of shallow, water filled sandy depression in an open forest, 0.25 mi S of the Boehler intersection, 23 May 1975, *J. & C. Taylor 18542A.*

PARNASSIA GRANDIFOLIA DC. CHOCTAW CO.: abundant in bog 11 mi NW of Hugo, 22 Aug 1976, *J. & C. Taylor and J. R. Wright 23223*; 14 Sep 1976, *J. & C. Taylor 23596*; and 2 Oct 1976, *J. & C. Taylor 23797.*

AESCHYNOMENE INDICA L. MCCURTAIN CO.: edge of a rice field near the dam of Barney Ward Lake, 1.5 mi SW of Tom, 19 Oct 1974, *J. & C. Taylor 17208*. Growing with this species was *Cuscuta attenuata* and *Ipomoea wrightii.*

AMORPHA PANICULATA T. & G. MCCURTAIN CO.: grazed field east of Barney Ward Lake, about 1.3 mi SW of Tom, 4 Jun 1976, *J. & C. Taylor 21590.*

COLUTEA ARBORESCENS L. CIMARRON CO.: rocky draw about 0.5 mi E of Kenton, population covering about one acre, 19 Jun 1976, *J. Taylor 22040.*

GERANIUM DISSECTUM L. MCCURTAIN CO.: edge of a rice field near the dam of Barney Ward Lake, 1.5 mi SW of Tom. 29 Apr 1975, *J. & C. Taylor 18413.*

POLYGALA CRUCIATA L. PUSHMATAHA CO.: bog 5.5 mi W of Antlers, 22 Aug 1976, *J. & C. Taylor and J. R. Wright 23243.*

BOWLESIA INCANA Ruiz. & Pav. COTTON CO.: base of *Tamarix gallica* growing in floodplain of the Red River just W of the US hwy. 277 and 281 bridge, SW of Randlett, 2 May 1976, *J. & C. Taylor 21166.*

ERYNGIUM INTEGRIFOLIUM Walter. Reported by Goodman (1974) based on *E. J. Palmer 8998* (MO). We have collected it from PUSHMATAHA CO.: bog on west side of road, 10.5 mi N and 1 mi W of Soper, 4 Sep 1975, *J. & C. Taylor 20461*; and bog 5.5 mi W of Antlers, 1 Sep 1976, *J. Taylor 23379*, CHOCTAW CO.: bog 11 mi NW of Hugo, 14 Sep 1976, *J. & C. Taylor 23603.*

CYNOCTONUM SESSILIFOLIUM Walter ex J. F. Gmelin. ATOKA CO.: bog 0.5 mi NW of Boehler and 20 mi SE of Atoka, 13 Aug 1976, *J. & C. Taylor 23200.*

LYSIMACHIA QUADRIFLORA Sims. CHOCTAW CO.: bog 11 mi NW of Hugo, 22 Aug 1976, *J. & C. Taylor and J. R. Wright 23237*; and *J. & C. Taylor 23614*, 14 Sep 1976. Ray (1956) lists this species for Arkansas.

PHLOX PANICULATA L. MCCURTAIN CO.: southwest bank of the Mt. Fork River about 8 mi NE of Smithville, 21 Oct 1976, *J. Taylor 23958.* Listed by Waterfall (1969) as seen only from cultivation.

SCUTELLARIA INTEGRIFOLIA L. MCCURTAIN CO.: from 2.7 mi N of Tom, 4 Jun 1976, *J. & C. Taylor 21605.* The plants were growing with *Eustylis purpurea.*

LINARIA CANADENSIS (L.) Dum. var. CANADENSIS. ATOKA CO.: sandy soil near the edge of a bog 0.5 mi NW of Boehler, 6 May 1975, *J. & C. Taylor 18450*, and from an open sandy upland forest 130 m S of the Boehler intersection, 23 May 1975, *J. & C. Taylor 18521.* This taxon may be easily distinguished from *L. texana* (*L. c.* var. *texana*) by its smaller purple flowers and in our area always in very sandy soil.

BACOPA MONNIERI (L.) Penn. MCCURTAIN CO.: along the 1941 cutoff blind lake of the Red River, 3.5 mi E and 8.5 mi S of Idabel, 2 Aug 1976, *J. & C. Taylor 22826.* It was found growing with *Stenotaphrum secundatum.*

EPIFAGUS VIRGINIANA (L.) Bart. MCCURTAIN CO.: southwest bank of the Mt. Fork River about 8 mi NE of Smithville, 21 Oct 1976, *J. Taylor 23960.* Two clumps were found growing under a large beech tree. It has been known previously close by in Arkansas.

UTRICULARIA INFLATA Walt. ATOKA CO.: very abundant in a shallow water filled sandy depression in an open forest 0.25 mi S of the Boehler

intersection, 6 May 1975, *J. & C. Taylor 18433*. An additional sheet of this species was found in our herbarium from MCCURTAIN CO.: swamp, 2.5 mi S of Eagletown, 17 Jun 1967, *Johnson 90*.

UTRICULARIA SUBULATA L. ATOKA CO.: bog 0.5 mi NW of Boehler, 6 May 1975, *J. Taylor 18449*; PUSHMATAHA CO.: bog 5.5 mi W of Antlers, 1 Sep 1976, *J. & C. Taylor 23392*. This small terrestrial species was growing among *Lycopodium adpressum* at the Atoka location and with *Burmannia capitata* and *Bartonia paniculata* in Pushmataha County.

ASTER PTARMICOIDES (Nees) T. & G. JOHNSTON CO.: established on the Baum Limestone, 2.9 mi NW of Mansville, 7 Sep. 1973, *J. & C. Taylor 14856*. At OKL, two additional sheets were found in the *Aster* innomen folder from the same location: *Perino & Massey 846*, 13 May 1971; and *J. Williams 525* (marked *A. ptarmicoides*), 4 Sep 1971. This species was not present in the area in 1960 when the senior author was researching the Grassland Communities on the Baum Limestone (Taylor & Penfound, 1961). Anderson and Creech (1975) believe this species is more closely related to *Solidago* than *Aster*.

CIRSIUM MUTICUM (Michx.) Pers. CHOCTAW CO.: bog 11 mi NW of Hugo, 22 Aug 1976, *J. & C. Taylor and J. R. Wright 23229*; and 14 Sep 1976, *J. & C. Taylor 23609*.

EUTHAMIA GRAMINIFOLIA (L.) Nutt. CHOCTAW CO.: bog 11 mi NW of Hugo, 22 Aug 1976, *J. & C. Taylor and J. R. Wright 23216*; PUSHMATAHA CO.: bog 5.5 mi W of Antlers, 1 Sep 1976, *J. & C. Taylor 23370*. Very isolated and disjunct from its distribution in the northern and eastern United States, the closest population occurring in northern Missouri.

EUTHAMIA LEPTOCEPHALA (T. & G.) Greene. CHOCTAW CO.: at Unger between US hwy. 70 and the railroad track, 5 Nov 1971, *J. & C. Taylor 9416*; MCCURTAIN CO.: Barney Ward Lake, 2 mi W of Tom, 22 Jul 1972, *J. & C. Taylor 11121*. We include the citation of these specimens to clarify the status of this species in Oklahoma. Waterfall (1969) includes this taxon as part of the *E. gymnospermoides* complex. Sieren (1970) and Taylor (1975) offer conclusive evidence of its distinctness. At the Unger location, both *E. leptocephala* and *E. gymnospermoides* were growing intermixed together. Occupation of the same habitat has been noted both in Texas and in Louisiana, but no evidence of intergradation has been observed.

EVAX CANDIDA (T. & G.) Gray. ATOKA CO.: sandy open forest about 130 m S of the Boehler intersection, 23 May 1975, *J. & C. Taylor 18523*.

ONOPORDUM ACANTHIUM L. ROGER MILLS CO.: roadside about 2.5 mi W of Strong City, 18 Jun 1976, *J. Taylor 21868*. This weedy thistle is known from Kansas and Texas, so its occurrence in Oklahoma was to be expected. It is a native of Europe.

SOLIDAGO ARGUTA Ait. var. BOOTTII (Hook.) Pal. & Stey. Not currently considered a part of the Oklahoma flora, but reported as early as 1900 as

S. Boottii by Bogue. *Solidago arguta* was used in Van Vleet's list in 1902. Our specimen *J. & C. Taylor 14928* from LEFLORE CO. north flank of Blue Bouncer Mt. along a branch of Eagle Fork Creek, 11 mi NE of Octavia, 18 Sep 1973, documents this taxon as a valid member of the Oklahoma Flora. It has since been collected from MCCURTAIN CO. along Mt. Fork River, Beavers Bend State Park, 18 Sep 1976, *J. & C. Taylor 23628*; CHEROKEE CO.: stream below McSpadden Falls, 6 Sep 1976, *J. & C. Taylor 23401*. It has been seen and identified elsewhere in the Ouachita Mts. and Ozark Plateau of Oklahoma. It should not be considered as rare.

Bogue had annotated his *S. Bootii* "Frequent in dry shaded situations," the name evidently being misapplied to *S. ulmifolia* (*S. delicatula*) which is very common throughout east central Oklahoma in the dryer blackjack-post oak forests. The var. *Boottii* is found in the moister habitats of stream bottoms in oak-hickory forests and blooms later in the fall, after the late summer flowering of *S. ulmifolia* is nearly terminated.

SOLIDAGO FLEXICAULIS L. MCCURTAIN CO.: along the west bank of the Mt. Fork River, 8 mi NE of Smithville, 21 Oct 1976, *J. & C. Taylor 23961*.

SOLIDAGO GIGANTEA Ait. var. GIGANTEA. MCCURTAIN CO.: roadside ditch, 2.8 mi N of Tom, 14 Sep 1974, *J. & C. Taylor 16996*; CHOCTAW CO.: bog 11 mi NW of Hugo, 22 Aug 1976, *J. & C. Taylor 23226*. The pubescence on the stems and leaves separates this variety from the very common glabrous stem and leaved *S. g.* var. *leiophylla*.

SOLIDAGO PATULA Muhl. var. STRICTULA T. & G. MCCURTAIN CO.: disturbed roadside with windrows of bulldozed trees, along hwy. 87, 2 mi S and 0.4 mi W of Tom, 18 Sep 1976, *J. & C. Taylor 23641*.

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TAXONOMY AND GEOGRAPHY OF *NICOLLETIA* (COMPOSITAE: TAGETEAE)

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Nicolletias are easily distinguished from other Tageteae by pinkish to magenta stripes or bands on the laminae of the white to pink ray corollas, a peculiar pappus of fascicles of coarse bristles alternating with and subtending lanceolate, awn-tipped squamellae, and, apparently, a novel chromosome base number, $x = 10$. Geographic ranges of the three species are allopatric and each is restricted to a single floristic province (Fig. 1): *Nicolletia edwardsii* in Chihuahuan Desert, *N. occidentalis* in Mojave Desert, and *N. trifida* in Sonoran Desert of Lower California.

Position of *Nicolletia* within Tageteae is puzzling. Morphologically, its nearest relative is *Leucactinia* Rydb., a little known monotype with white to pale yellow ray corollas, a pappus of coarse bristles (the innermost sometimes narrowly hyaline-margined at base), and chromosome number unknown. *Leucactinia* is known from only five localities in Nuevo Leon, Coahuila, San Luis Potosi, and Aguascalientes. Isolation of this pair of genera within Tageteae probably reflects an early derivation from ancestral Tageteae (Strother, 1977).

CHROMOSOMES

All species of *Nicolletia* have been reported to have $2n = 10$ II in four to six populations of each. The base chromosome number for the genus is taken to be $x = 10$. Base numbers for other genera of Tageteae are: 7, 8, 9, 11, 12, 13, and 15; base numbers of seven of the 16 genera remain unknown.

One population of *N. trifida* (30 miles south of San Filipe, *Powell and Turner 1739*, DS, NY, US) has been reported to have $n = 20$. Additional counts of $2n = 10$ II from *N. occidentalis* are reported here: CA, Los Angeles Co., ca. 11 and 12 miles east of Palmdale, *Strother 1221* and *1222*, UC.

TAXONOMY

NICOLLETIA A. Gray in Frémont, Rep. exped. Rocky Mts. p. 315. 1845.
Type: *Nicolletia occidentalis* A. Gray.

Annuals or perennial herbs; stems spreading to erect, 5—30 (—50) cm high at anthesis; glabrous, often glaucous. Leaves mostly alternate (lowermost opposite); pinnately divided into 3—9 (0—11) stout to linear-filiform lobes, these usually bristle-tipped and bearing a subterminal, orangish, pellucid gland containing strongly scented oil. Heads terminating branches, subsessile or pedunculate. Involucres turbinate to fusiform or campanulate; 12—18 mm high. Calyculus of 0—6 short, lanceolate to triangular bractlets.

SIDA 7(4): 369—374.

Phyllaries 8—12; free to base; imbricate; membranous, narrowly scarious-margined; most bearing 1—5, oval to linear, pellucid glands; persistent and becoming reflexed. Receptacle convex to hemispheric or conical; favose to alveolate; sparsely and minutely hispid to glabrous. Ray florets 8 (7—12); pistillate, fertile; corollas white to pink, laminae usually with bands or stripes of magenta or pink, very showy, apically retuse or shallowly 3-lobed. Disc florets 15—100+; perfect, fertile; corollas pale to bright yellow, sometimes tipped with purple, narrowly cylindrical, 7—9 mm long, tube much shorter than the throat, lobes 5, deltoid to lanceolate; anthers minutely sagittate; style branches long, slender, tipped with filiform, hispidulous, astigmatic appendages. Achenes slender, somewhat clavate, blackish, closely pubescent with short, white to rufous hairs. Pappus of 5 (—6) fascicles of 7—15 fine to coarse, hispidulous bristles subtending and alternating with 5 (—6) lanceolate, awn-tipped squamellae.

Key to *Nicolletia*

a. Leaves mostly 3—5-lobed, rachis scarcely wider than lobes; laminae of ray corollas 7—16 mm long; disc florets mostly 15—50 per head.
  b. Leaf lobes mostly patent; peduncles 5—30 mm long, heads held scarcely above foliage; laminae of ray corollas mostly 9—16 mm long; Chihuahuan Desert. . . . . 1. *N. edwardsii*
  bb. Leaf lobes mostly antrorse; peduncles 10—70 mm long, heads held well above foliage; laminae of ray corollas 7—11 mm long; Lower California. . . . . 2. *N. trifida*
aa. Leaves mostly 7—9-lobed, rachis mostly 2—3 times as wide as lobes; laminae of ray corollas 4—8 mm long; disc florets mostly 60—100+ per head; Mojave Desert. . . . . 3. *N. occidentalis*

1. NICOLLETIA EDWARDSII A. Gray, Smithsonian Contr. Knowl. 3(5):119. (Pl. wright. pt. 1) 1852. Type: Mexico, Chihuahua, "near Guajuquilla" (present Cd. Jimenez, near 27°N, 105°W), Aug, *Dr. Edwards s.n.* Holotype: NY!

Annuals (or short-lived perennials); spreading, mostly 5—25 cm high, weakly succulent, sometimes weakly glaucous. Leaves 1—6 cm long, pinnately parted into 3—5 linear to filiform, usually patent lobes (or simple and filiform), sometimes with additional short, lateral lobes. Peduncles 5—15 (—30) mm long, heads held scarcely above foliage. Involucres narrowly turbinate to weakly fusiform. Calyculus of 4—6 triangular bractlets 1—2 mm long. Phyllaries mostly 6—8, lanceolate, acute to attenuate, 11—15 mm long, 2.2—4.1 mm wide, membranous, hyaline-margined, each usually bearing 1 subapical and 2—4 submarginal, linear pellucid glands. Ray florets 8 (7—9); tube of corolla slender, 4.2—6.2 mm long; laminae linear to narrowly elliptic, 7—16 mm long, 3—6 mm wide; style branches exserted 0.1—1.1 (—2.2) mm. Disc florets 15—25 (—50); corollas creamy yellow, 7—8 mm long, tube 1.5—1.7 mm long, throat narrowly cylindrical, ca. 5 mm long, lobes 0.4—0.7 mm long, deltoid to lance-triangular, papillose and sparsely glandular-puberulent; anthers ca. 3.5 mm long, including basal collar (0.3—0.4 mm long) and apical appendage (0.4—0.5 mm long); style

branches 2.5—2.7 mm long, including appendage (1.7—2.2 mm long). Achenes 5—7 mm long. Pappus bristles 3—5 mm long; squamellae 4.8—7.2 mm long, including awn (1.8—3.3 mm long).

Distribution (Fig. 1): Chihuahuan Desert from trans-Pecos Texas south and east to northern Zacatecas. Locally common to abundant on sandy to silty, often calcareous or gypseous, soils on flats or playas in *Larrea* Scrub; 800—1650 m. Flowering mostly Aug—Oct, following summer rains; occasional through the year (Fig. 1).

2. NICOLLETIA TRIFIDA Rydb., N. Amer. Fl. 34:180. 1915. Type: Mexico, Baja California, Bahia de los Angeles (ca. 29°N, 113°35'W), Apr—Dec 1887, *E. Palmer 569*. Holotype: NY!; isotypes: GH!, NY!, UC!, US!

Annuals or short-lived perennials; ascending to stiffly erect, 1—3 (—5) dm high, often succulent and glaucous. Leaves 3—5 (1—7) cm long, pinnately parted into 3 (0—5) linear-terete, antrorse (30—45°) lobes. Peduncles 2 (1—7) cm long, heads usually held well above foliage. Involucres narrowly turbinate to somewhat fusiform or campanulate. Calyculus of 0—2 lance-triangular bractlets 1—2 mm long. Phyllaries 8 (7—10), lance-linear to oblanceolate, attenuate or abruptly acute, 12—16 mm long, 2.5—3.8 mm wide, very thin, hyaline-margined, each usually bearing a conspicuous subapical gland and, rarely, with 2—4 lateral, linear glands. Ray florets 8 (—11); tube of corollas 4.8—6.5 mm long; laminae ovate-elliptic, 7—11 mm long, 2.5—5.2 mm wide; style branches exserted 0.8—2.2 mm. Disc florets 30—50 (—80); corollas yellow, 7.2—8.9 mm long, tube 1.8—2.7 mm long, throat 4.5—5.1 mm long, gradually dilated, lobes 0.9—1.1 mm long, narrowly triangular, papillate, not glandular-puberulent; anthers 3.5—3.9 mm long including collar (0.4—0.6 mm long) and apical appendage (0.6—0.8 mm long); style branches 3.1—3.8 mm long, including appendage (1.1—1.5 mm long). Achenes 5—8 mm long. Pappus bristles 3—6 mm long, very fine; squamellae 4.2—7.7 mm long including awn (0.7—2.2 mm long).

Distribution (Fig. 1): Sonoran Desert portion of Lower California between 24° and 30°30' N; 0—1300 m. Flowering mostly Feb—May and Oct—Nov, following rains; occasional through the year (Fig. 1).

Achenes of *N. trifida* seem eminently suited for disperal and much of western Sonora and the islands of the Gulf of California seem to provide ample hospitable habitats, yet *N. trifida* has been reported from only one of the islands (Isla Inez, very near the coast of Baja California Sur at ca. 27° N, *I.M. Johnston 3654*, CAS, GH) and not at all from Sonora.

3. NICOLLETIA OCCIDENTALIS A. Gray in Frémont, Rep. exped. Rocky Mts. p. 316. 1845. Type: California, "banks of Mohahve river, growing in naked sands," Apr 1844, *Frémont "358"*. Holotype: NY!; isotypes: GH!, NY!

Perennials; strictly erect from deep taproots; 12—29 cm high; glaucous. Leaves at very base (soil level and below) reduced to scales, normal leaves 2—7 cm long, pinnately parted into 7—9 (5—11) short, patent or antrorse

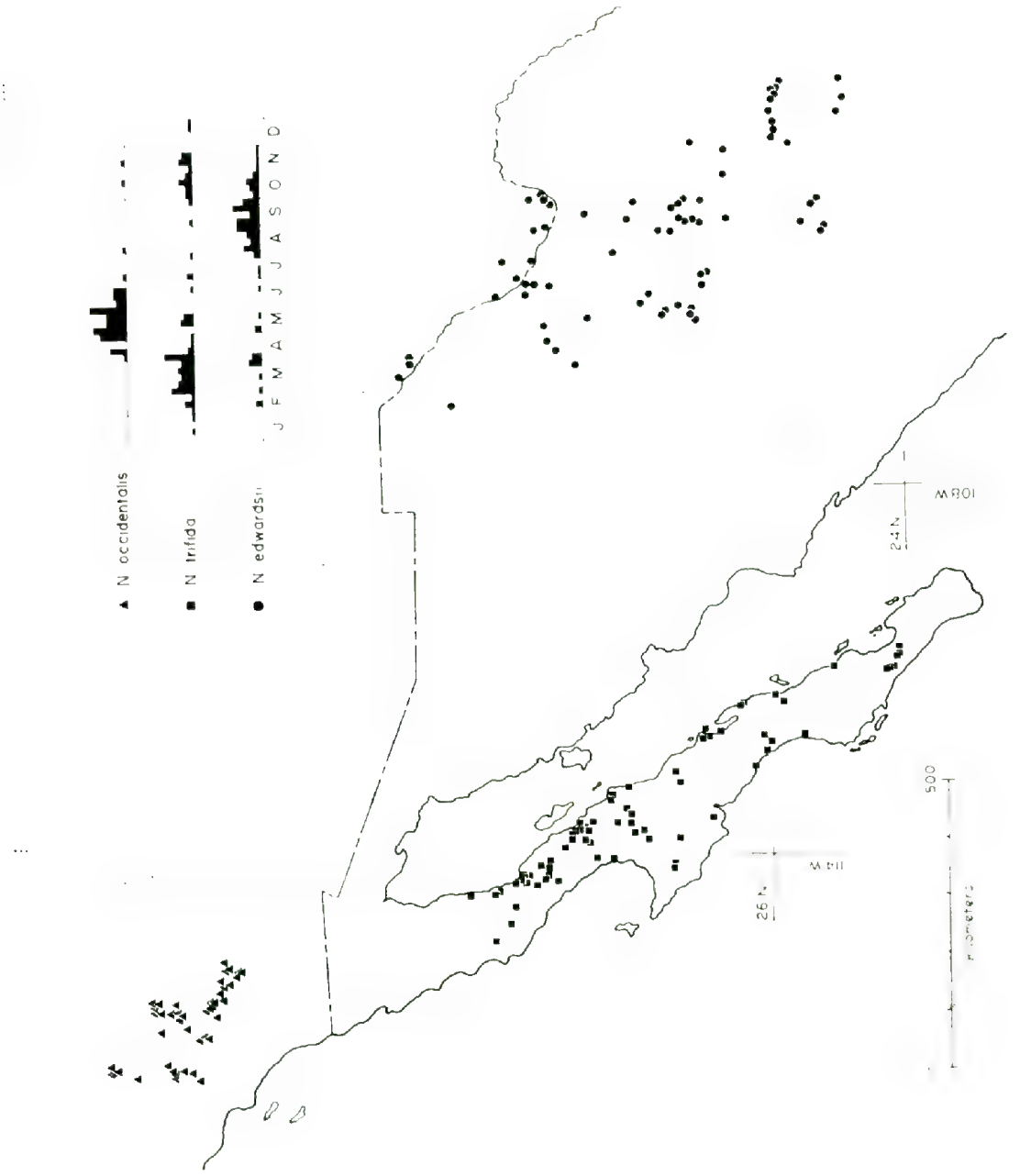

Fig. 1. Distributions of *Nicolletia* spp. Histograms indicate flowering times as determined from cumulative herbarium records.

lobes, fleshy and often crowded below the heads. Peduncles mostly 2—10 mm long, heads surpassed by foliage. Involucres broadly turbinate to cylindrical. Calyculus of 2—4 lanceolate to triangular bractlets 4—8 mm long. Phyllaries 8 (—12), linear to ovate, abruptly acute to acuminate, 14—18 mm long, 3.5—5.5 mm wide, somewhat fleshy, narrowly scarious-margined, often tinged with purple, each bearing 0—1 subapical and 0—4 submarginal glands. Ray florets 8—12; tube of corollas 5.5—6.5 mm long; laminae narrowly ovate-elliptic, 4.5—8.5 mm long, 2.5—3.8 mm wide; style branches exserted 2.8—3.8 mm. Disc florets (30—) 60—100+; corollas yellow, often tipped with purple, 8.2—9.5 mm long, tube 2.2—3.0 mm long, throat 4.8—5.5 mm long, lobes 0.8—1.1 mm long, deltoid, papillate, not glandular-puberulent; anthers 3.8—4.5 mm long including collar (0.4—0.5 mm long) and apical appendage (0.7—0.8 mm long); style branches 3.2—3.5 mm long, including appendage (0.9—1.2 mm long). Achenes 7—9 mm long. Pappus bristles 3—7 mm long; squamellae 6—8 mm long, including awn (1—2 mm long).

Distribution (Fig. 1): California, Mojave Desert from northeastern Kern Co. south into northeastern Los Angeles Co. and east and south across western San Bernardino Co. into north central Riverside Co. (Joshua Tree National Monument). Locally common in deep sands, often in floors of washes; 600—1400 m. Flowering mostly Apr—Jun, following winter rains (Fig. 1).

The often cited occurrence of *N. occidentalis* in San Diego Co., California, is apparently based on mislabelled specimens (*S.B. and W.F. Parish 193*). Some of these (GH, MO, US) read "sandy banks of Mojave River, May 1882." On others (DS, F, NY, PH, US), printed labels read "San Diego Co., San Felipe" and either May or June, 1882. Two of the latter have the printed locality struck through and "Mojave R" (NY) or "Mojave Desert" (US) written in. I have seen no other collections attributed to San Diego Co.

GEOGRAPHY

Distances separating geographic ranges of species pairs in *Nicolletia* are considerable: *edwardsii/occidentalis*—1000 km, *edwardsii/trifida*—650 km, and *occidentalis/trifida*—400 km (Fig. 1). Historical development of this distribution pattern invites speculation. The ancestral population of *Nicolletia* probably resided in central Mexico, center of diversity for Tageteae (Strother, 1977). But, how did *N. trifida* get to Lower California? How did *N. occidentalis* get to Mojave Desert? Long distance dispersal and colonization followed by differentiation in response to selection? Migrations of ancestral stock and subsequent differentiations and extinctions?

Comparative morphology of Nicolletias offers little help in reaching a conclusion, in making a choice between alternative hypotheses. No single species seems to be markedly more "primitive" or "archetypal" than the others. In *Dyssodia* subg. *Clomenocoma*, however, there is a group of species that form a definite, linear, morphological sequence from primitive to

advanced (Strother, 1969). Geographical distribution of this series of species has implications for interpreting the biography of *Nicolletia*.

In subg. *Clomenocoma*, *Dyssodia aurantia* and *D. appendiculata* are morphologically primitive and closely approximate a hypothetical archetype for *Dyssodia* in particular and Tageteae in general. *Dyssodia aurantia* is restricted to Veracruz; *D. appendiculata* ranges across southern Mexico from Chiapas to Colima. *Dyssodia squamosa* is closely related to *D. appendiculata* and ranges northwest of the latter from Jalisco through Nayarit into Sinaloa. Next in this series is *D. speciosa*, which is restricted to southern Baja California Sur. It is followed by *D. porophylloides*, which ranges from mid-peninsular Lower California into California, Arizona, and Sonora. The series ends with *D. cooperi*, which ranges north from *D. porophylloides* in California and Arizona into southern Nevada (Strother, 1969). This morphological/geographical sequence in *Dyssodia* correlates closely with a continuum of increasing aridity of habitats (Walter and Lieth, 1967). *Dyssodia appendiculata* occupies rather mesic habitats and the habitat of *D. cooperi* is the most xeric of the series.

Nicolletias cannot be placed so readily into a linear evolutionary sequence, nor do they cover such a broad spectrum of habitats. Still, a history of migration from the Chihuahuan Desert region into the Sonoran and Mojave deserts followed by differentiations and extinctions seems to be a plausible explanation for present distributions of these species.

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CHROMOSOME NUMBERS IN *ERIGERON* AND *CONYZA* (COMPOSITAE)

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Though reports of chromosome numbers in the Compositae are extensive, the genus *Erigeron* has received relatively little attention. Of the approximately 147 currently recognized North American species north of Mexico, only about 66 have been studied cytologically, and infraspecific variation in chromosome number is known in about 26 of these. The counts reported here are from collections made mostly during the last three years and are peripheral to a more inclusive study of *Erigeron*.

Chromosome numbers are presented for 74 collections representing 1 species of *Conyza* and 23 of *Erigeron*; 9 are for previously unreported taxa and 1 differs from an earlier report for the same taxon. Counts were made either from buds fixed in the field with Farmer's solution (acetic alcohol 3:1; Sass, 1958) or from radicles grown from achenes in the laboratory, pretreated for 4 hours in 8-hydroxyquinoline, and fixed in Farmer's solution. Vouchers are deposited at NCU or at Jacksonville State University, Alabama; duplicates are at TEX and DUKE. Thanks go to Miklos Treiber for collecting buds and vouchers of several species and to David Whetstone, from whose Alabama collections achenes of *E. strigosus*, *E. annuus*, and *C. canadensis* were taken.

Table I. Species of *Erigeron* and *Conyza* examined for chromosome number.

Taxon	Chromosome number 2n	Locality and Collection
CONYZA:		
C. canadensis (L.) Cronq.	18 (1)†	ALABAMA: Cullman Co., just SE of Oak Level. *Whetstone 4845.*
	18 (8)	ALABAMA: Marshall Co., Guntersville. *Whetstone 6335.*
	9_{II}	LOUISIANA: LaSalle Parish, Olla. *Nesom R313.*
	9_{II}	NORTH CAROLINA: Jackson Co., Cashiers. *Nesom R309.*
ERIGERON:		
E. annuus (L.) Pers.	27 (1)	ALABAMA: DeKalb Co., 5 mi S of Ft. Payne. *Whetstone 3520.*

SIDA 7(4): 375—381.

	27 (3)	ALABAMA: Etowah Co., Walnut Grove. *Whetstone 4091.*
	27 (1)	ALABAMA: Franklin Co., 1 mi S of Russellville. *Whetstone 4474.*
	27 (5)	ALABAMA: Walker Co., 4 mi W of Jasper. *Whetstone 4728.*
	27_{I}	NORTH CAROLINA: Orange Co., Chapel Hill. *Nesom R319.*
	27_{I}	VIRGINIA: Pittsylvania Co., Gretna. *Treiber 1476.*
**E. basilobatus* Blake	27_{II}	MEXICO; NUEVO LEON: Cerro Potosí, 8 mi WNW of Galeana. *Nesom R566.*
	36_{II}	MEXICO; NUEVO LEON: Peña Nevada, ca. 35 mi E of Doctor Arroyo. *Nesom R574.*
E. bellidiastrum Nutt. var. *bellidiastrum*	9_{II}	UTAH: Garfield Co., 11 mi E of Escalante. *Nesom R38.*
	9_{II}	NEW MEXICO: Torrance Co., 19 mi SE of Willard. *Nesom R656.*
E. eatoni A. Gray subsp. *eatoni*	9_{II}	COLORADO: Mesa Co., 7 mi S of Mesa. *Nesom R11B.*
	9_{II}	COLORADO: Grand Co., 5 mi S of Grand Lake. *Nesom R355.*
	9_{II}	COLORADO: Gunnison Co., Sapinero. *Nesom R10.*
E. eximius Greene	18_{II}	NEW MEXICO: Taos Co., 1.5 mi E of Taos Ski Valley. *Nesom R681.*
	18_{II}	NEW MEXICO: Bernalillo Co., E side of Sandia Peak summit. *Nesom R669.*
	$12_{II} + 3_{IV}$	
	36 (4)	NEW MEXICO: Taos Co., 9 mi SE of Rodarte. *Nesom R684.*
**E. formosissimus* Greene var. *formosissimus*	9_{II}	NEW MEXICO: Sandoval Co., 22 mi W of Los Alamos. *Nesom R241.*
	9_{II}	NEW MEXICO: Rio Arriba Co., 2 mi W of Tres Piedras. *Nesom R672.*
**E. formosissimus* Greene var. *viscidus* (Rydb.) Cronq.	9_{II}	NEW MEXICO: Sandoval Co., 18 mi W of Los Alamos. *Nesom R240.*
	9_{II}	NEW MEXICO: Colfax Co., 11 mi SSW of Eagle Nest. *Nesom R213A.*
	18_{II}	NEW MEXICO: Bernalillo Co., 6 mi NW of Sandia Peak. *Nesom R665.*
	18 (5)	NEW MEXICO: Rio Arriba Co., 10 mi NW of Tres Piedras. *Nesom R676.*

**E. leiomerus* A. Gray	18 (1)	NEW MEXICO: Valencia Co. *Spellenberg 4912.*
E. lonchophyllus Hook.	9_{II}	COLORADO: Chaffee Co., 7 mi E of Buena Vista. *Nesom R314.*
**E. palmeri* A. Gray	18 (1)	MEXICO, NUEVO LEON: NE of Peña Nevada, 39 mi E of Doctor Arroyo. *Nesom R578.*
E. peregrinus (Pursh) Greene subsp. *callianthemus* (Greene) Cronq. var. *callianthemus*	18 (4)	NEW MEXICO: Taos Co., ca. 6 mi S of Red River. *Nesom R680.*
E. philadelphicus L.	9_{II}	LOUISIANA: Natchitoches Parish, Natchitoches. *Nesom R320.*
	9_{II}	NORTH CAROLINA: Burke Co., 6 mi S of Jonas Ridge. *Treiber 1411.*
	9_{II}	NORTH CAROLINA: Watauga Co., 4 mi E of Boone. *Treiber 1422.*
	9_{II}	PENNSYLVANIA: Cumberland Co., Carlisle. *Treiber 1478.*
E. pinnatisectus (A. Gray) A. Nels.	9_{II}	COLORADO: Clear Creek Co., Guanella Pass. *Nesom R258.*
E. platyphyllus Greene	9_{II}	NEW MEXICO: Lincoln Co., Sierra Blanca Ski Area. *Nesom R654.*
	18 (2)	NEW MEXICO: Otero Co., 9 mi NE of Cloudcroft. *Nesom R650.*
**E. potosinus* Standley	18_{II}	MEXICO, NUEVO LEON: Cerro Potosí, 8 mi WNW of Galeana.
	$8_{IV} + 2_{II}$	*Nesom R567.*
	9_{II}	MEXICO, NUEVO LEON: Cerro Potosí, 8 mi WNW of Galeana. *Nesom R568.*
E. pulchellus Michaux	9_{II}	NORTH CAROLINA: Alleghany Co., Blue Ridge Parkway, 1 mi S of jct with Hwy 18. *Treiber 1445.*
	9_{II}	NORTH CAROLINA: Buncombe Co., Blue Ridge Parkway, 2 mi SEE of Asheville. *Treiber 1432.*
	9_{II}	NORTH CAROLINA: Jones Co., Island Creek, 6 mi S of New Bern. *Nesom R315.*
	9_{II}	NORTH CAROLINA: McDowell Co., Blue Ridge Parkway, 1.5 mi SW of jct with Hwy 80. *Treiber 1429.*
	9_{II}	NORTH CAROLINA: Montgomery Co., 1 mi WNW of Uwharrie. *Nesom R316.*

	9_{II}	NORTH CAROLINA: Orange Co., Chapel Hill. *Schram 122.*
	9_{II}	VERMONT: Windsor Co., 2 mi W of Woodstock. *Treiber 1466.*
E. pumilis Nutt. subsp. *concinnoides* Cronq.	18 (1)	COLORADO: Gunnison Co., 10 mi NE of Almont. *Spongberg s.n.*
E. rusbyi A. Gray	9_{II}	NEW MEXICO: Otero Co., 1 mi S of Cloudcroft. *Nesom R644.*
E. strigosus Muhl. ex Willd.	18 (8) 27 (2)	ALABAMA: Marshall Co., 7.3 mi E of Douglas. *Whetstone 3218.*
	27 (3)	ALABAMA: Morgan Co., 3 mi N of Hulaco. *Whetstone 2916.*
	36 (3) 27 (1)	ALABAMA: Morgan Co., Falkville. *Whetstone 2995.*
	18 (4)	ALABAMA: Tuscaloosa Co., Holt, 2 mi NE of Tuscaloosa. *Whetstone 4666.*
	18 (3)	ALABAMA: Winston Co., 6 mi ESE of Haleyville. *Whetstone 4279.*
	27 (4)	ALABAMA: Winston Co., Haleyville. *Whetstone 4499.*
	18 (6) 27 (2)	FLORIDA: Liberty Co., 5 mi E of Torreya State Park. *Nesom R325.*
	ca. 27_{I}	KENTUCKY: Hopkins Co., 2 mi N of Madisonville. *Nesom R305.*
	18 (1) 27 (1)	MISSISSIPPI: Harrison Co., Gulfport. *Nesom R324.*
	27 (2)	TEXAS: Kaufman Co., 24 mi E of Dallas. *Nesom R317.*
**E. subtrinervis* Rydb. subsp. *subtrinervis*	9_{II}	COLORADO: Alamosa Co., Great Sand Dunes Natl. Mon. *Nesom R248.*
	9_{II}	COLORADO: Park Co., 1 mi E of Weston Pass. *Nesom R288.*
	9_{II}	COLORADO: Park Co., 4 mi E of Grant. *Nesom R260.*
	9_{II}	COLORADO: Park Co., 8 mi SW of Lake George. *Nesom R272.*
	9_{II}	NEW MEXICO: Bernalillo Co., E side of Sandia Peak summit. *Nesom R667.*
	9_{II}	NEW MEXICO: Colfax Co., 0.5 mi ESE of Red River Pass. *Nesom R215.*
	9_{II}	NEW MEXICO: Rio Arriba Co., San Antonio Peak, 16 mi N of Tres Piedras. *Nesom R247.*
	9_{II}	NEW MEXICO: Taos Co., 11 mi E

		of Taos. *Nesom R207.*
	9_{II}	NEW MEXICO: Taos Co., 3 mi SW of Taos Ski Valley. *Nesom R223.*
**E. tenuis* T. & G.	9_{II}	LOUISIANA: Natchitoches Parish, 1 mi W of Natchitoches. *Nesom R318.*
	36 (1)	MISSISSIPPI: Hancock Co., Waveland. *Nesom R321.*
‡*E. utahensis* A. Gray	18 (1)	UTAH: Garfield Co., 2 mi E of Tropic. *Nesom s.n.* (no voucher).
**E. vetensis* Rydb.	9_{II}	COLORADO: Grand Co., 5 mi S of Grand Lake. *Nesom R354.*
E. vernus (L.) T. & G.	18 (4)	GEORGIA: Worth Co., 7 mi N of Sylvester. *Nesom R326.*
	18 (1)	MISSISSIPPI: Hancock Co., 3 mi W of Waveland. *Nesom R322.*
	9_{II}	MISSISSIPPI: Pearl River Co., Picayune. *Nesom R323.*

* First report for the taxon.

‡ First report of this chromosome number for the taxon.

† Numbers in parentheses after mitotic counts refer to the number of radicles for which the chromosome number was determined. All radicles for each collection were grown from achenes of a single head.

DISCUSSION

The first counts for *Erigeron formosissimus* (n=9, n=18) are given here. There are no apparent characters in the tetraploid plants from Bernalillo Co., N. M., which would distinguish them from known diploids of this taxon. However, immediately adjacent to the diploid clone of *E. formosissimus* var. *viscidus* from Colfax Co., N. M. (*Nesom R213A*), a clump of the same species (*Nesom R213B*) was collected which had produced pollen with extremely low stainability and much irregularity in size, indicating that it is probably polyploid. This putative polyploid clone has typical glandularity on the phyllaries and upper peduncle but differs from the adjacent, more typical, var. *viscidus* in having a noticeably more strigose involucre.

The tetraploid counts for *Erigeron eximius* (=*E. superbus* Greene, see Weber, 1973) in the Sangre de Cristo Range are interesting in that the previous tetraploid report for this species is from the Front Range in Boulder Co., Colo. (Love and Kapoor, 1967). A diploid count has been reported from Cochise Co., Ariz., by Watson (1973). The presence of tetravalents in the Bernalillo Co., N. M., plants suggests that they may be of autoploid origin.

Erigeron potosinus is known from Cerro Potosí in southern Nuevo Leon and from two additional localities in Tamaulipas, Mexico. It appears to be extremely closely related to *E. eximius*, and the two may eventually prove to be conspecific. Plants of both taxa produce herbaceous rhizomes, but

those of *E. potosinus* do so more prolifically and produce more dense clonal colonies. Both collections of *E. potosinus* reported here were made on the ENE side of Cerro Potosí in a subalpine meadow with scattered pines at about 3200-3300 meters in elevation, below the summit of about 3650 to 3820 meters (Beaman and Andresen, 1966). The second collection (*R568*) was made about 100 meters below the first (*R567*). From the first collection tetraploid counts were obtained from two plants; in both of them multivalent associations were observed and pairing ranged from 8_{IV}'s + 2_{II}'s to 18_{II}'s (though some loose pairing may have been present in the latter cell). Pollen from eight other plants from this locality was found to be over 96% abortive. Tetrads were formed most commonly, though some pentads were noted, but micrograins were commonly formed with the tetrads to incorporate individual laggard chromosomes not reaching either pole. The more normal sized pollen grains were malformed and mostly devoid of cytoplasm. Gross meiotic abnormalities do not appear to account for the high pollen sterility in these tetraploids. From the second collection of *E. potosinus* (R568) clear diploid counts were obtained from three plants with meiosis and tetrad formation normal in each. Of seven other plants from this locality from which pollen has been examined, two have over 90% viable pollen and are probably diploid. The other five have from 95% to 35% abortive pollen; micrograins commonly occur in three of these plants and all five are probably polyploid.

Lack of morphological distinction between the diploids and tetraploids of *Erigeron potosinus*, other than perhaps a slight size difference, and the presence of multivalents in the tetraploids are strong circumstantial evidence that autoploids are being formed on Cerro Potosi. The only other species of *Erigeron* seen in this area were *E. basilobatus* Blake and *E.* cf. *nudiflorus* Buckley; both were growing at a much lower elevation than *E. potosinus* and are morphologically distinct. The two collections of *E. potosinus* known from Tamaulipas are *Stanford, Taylor,* and *Lauber 2501A* (TEX and SMU) and *Stanford, Taylor,* and *Lauber 2673* (SMU). Gross irregularities in the pollen examined of two plants from each of these localities indicate that they are probably polyploid.

Both collections of *Erigeron basilobatus* ($n=27_{II}$, $n=36_{II}$) have noticeably aborted pollen, although pairing was apparently normal in all the cells observed. Pollen from an isotype of this species (*Muller 2934*, SMU) showed a lowered viability, indicating that these plants are probably also polyploid. Muller's collection was made in Nuevo Leon as were the two reported here.

The first chromosome counts for *Erigeron tenuis* ($n=9_{II}$, $n=18_{II}$) are presented here. Besides the tetraploid count near the southeastern extremity of the range of the species in Hancock Co., Miss., four other plants examined from Oktibbeha, Pearl River, and Rankin Cos., Miss., are also probably polyploid—an estimate based on their production of extremely abortive pollen. Of these four only the collection from Rankin Co. (*Jones 18591.2*) is atypical of the species in any apparent way; on the herbarium label

(NCU) it is noted by Dr. Jones as being unusual and has exceptionally large basal and lower cauline leaves.

The discovery of diploid *Erigeron strigosus* from Mississippi, Alabama, and Florida confirms the report by Turner and Flyr (1966) of diploid *E. strigosus* from Florida and establishes this southern area as a center of sexual populations for the species. Checks of pollen size and stainability from other locations in Alabama show that diploids also occur in Franklin, Blount, and Cullman Counties. Numerous other chromosome counts over the range of this widespread colonizer have been polyploid. The production of relatively high percentages of achenes with euploid chromosome numbers different from that of the megasporangiate parent is a phenomenon being documented in greater detail in *Erigern flagellaris* A. Gray, *Erigeron divergens* T. & G., and their relatives (Nesom, in progress). *Erigeron strigosus* apparently hybridizes freely with *E. annuus*, but plants of the latter species have not yet been found at a level other than triploid.

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A SYNOPSIS OF NORTH AMERICAN *CORISPERMUM* (CHENOPODIACEAE)[1]

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ABSTRACT

Corispermum (Chenopodiaceae) is an Eurasian genus of annual herbs containing members which have become established in the North American flora. The taxonomy of the representatives of this genus occurring in North America has not received careful attention for some time. The most recent taxonomic revision of North American *Corispermum* was actually that of P. C. Standley (1916) in which the following species were recognized: *C. hyssopifolium* L., *C. nitidum* Kitaibel ex Schultes, *C. emarginatum* Rydberg, and *C. villosum* Rydberg. Standley considered the first two species to be introduced and the latter two native. In the present study, herbarium specimens were examined from 14 different herbaria. On the basis of literature and observations of these herbarium specimens, only three species of *Corispermum*, all introduced, are recognized in North America: *C. hyssopifolium* L., *C. nitidum* Kitaibel ex Schultes, and *C. orientale* Lamarck. A study of distributional data acquired from herbarium specimens and state floras suggests that the geographic range for all three species has increased with time.

INTRODUCTION AND METHODS

Corispermum (Chenopodiaceae), a genus of branched, annual herbs, is not native to North America. However, it has become well established in the North American flora. It is commonly found on dunes and sandy hills, beaches or sand flats, and along roadsides and railroad ballasts. The flowers are small, inconspicuous, and arranged in spikes located in axils of the bracts. The "bug-like" fruit, exposed in the bract axils, is often a prominent feature.

The genus is sometimes confused with several other chenopodiaceous taxa. *Kochia scoparia* (L.) Schrader resembles *Corispermum* in its habit, but the calyx of *Kochia* is lobed not more than half-way to the base and forms dorsal, membranous wings in fruit. The calyx of *Corispermum* is scarious, lobed to the base, and does not develop wings. *Salsola kali* L. is also superficially similar to *Corispermum*, but has a spirally coiled embryo with no endosperm, and the tips of the leaves and bracts are commonly spinulose. The embryo of *Corispermum* is annular, surrounding copious endosperm, and the leaves and bracts, though narrowed, are seldom spinulose.

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The genus *Corispermum* contains 50-60 species, 34 of which (along with several varieties) are included in *Flora of the U.S.S.R.* (Iljin, 1936). Although North American taxa of *Corispermum* are few in number, they have not received careful taxonomic attention for some time. A brief summary of the literature relevant to taxa found in North America will serve to support this point.

Schultes (1814) first published *Corispermum nitidum*, which had earlier been described, but not validly published, by Kitaibel. Several superfluous names were subsequently given to this species, including *C. tenue* Link (1820) and *C. microspermum* Host (1827); however, no North American variants have been proposed.

Corispermum hyssopifolium was described by Linnaeus (1753). In 1818 Nuttall published a North American variety of this species, *C. hyssopifolium* var. *americanum*. Later, he elevated this variety to the status of species, viz. *C. americanum* Nuttall (1834). In 1838 W. J. Hooker added several other North American varieties, including *C. hyssopifolium* var. *gracile*, *C. hysopifolium* var. *robustius*, and *C. hyssopifolium* var. *rubricaule*. Watson (1874) further increased the list of North American taxa with *C. hyssopifolium* var. *microcarpum*.

Around the turn of the century Rydberg described three supposedly new North American species: *Corispermum villosum* in 1897, *C. marginale* in 1903, and *C. emarginatum* in 1904. Macbride (1918) suggested that *C. villosum* Rydberg and *C. emarginatum* Rydberg actually represented the same taxon which he considered to be merely a variety of *C. orientale* (an Old World species), i.e. *C. orientale* var. *emarginatum* (Rydberg) Macbride. A few years after Rydberg's descriptions, two additional North American species were proposed: *C. imbricatum* Nelson (1909) and *C. simplicissimum* Lunell (1910). Nelson (1909) discussed the introduction of *Corispermum* in North America and indicated that its distribution at that time was "throughout the middle west."

The most recent revision of the North American taxa of this genus was that of Standley (1916), who recognized four species. These species and those names that Standley considered their synonyms are as follows: 1) *Corispermum hyssopifolium*: *C. hyssopifolium* var. *americanum*, *C. americanum*, *C. marginale*, *C. imbricatum*, *C. simplicissimum*; 2) *C. nitidum*: *C tenue*, *C. microspermum*, *C. hyssopifolium* var. *microcarpum*; 3) *C. emarginatum*; and 4) *C. villosum*. The first two species he thought to be introduced, while the latter two he considered native. Standley also mentioned *C. pilosum*, first described by Rafinesque (1836), but treated it as a doubtful species.

Standley's work, while admirable for its time, leaves many questions unanswered. Herbarium specimens are frequently misidentified, and the number of taxa which should be recognized, as well as the rank which should be accorded them, is uncertain. Furthermore, the native versus introduced status of various taxa is subject to question, and the geographic distribution

given for each species in 1916 has become outdated. The present study is thus an updated taxonomic revision of the North American species of *Corispermum*, including a reconsideration of each species' geographic range.

The conclusions of this study as to the number of taxa of *Corispermum* in North America and their taxonomic rank are based on literature and on personal observations of herbarium specimens. Measurements and other data included in the descriptions are from dried specimens. Over 950 herbarium specimens were examined, including both New and Old World material. The type specimens of most of the proposed North American taxa were examined. In all, specimens were studied from 14 different herbaria. Abbreviations are after Holmgren and Keuken, 1974: F, GH, MIN, MO, MU, NY, OSC, OSU, PH, RM, TEX, UC, US, and UT. The curators of these herbaria are gratefully acknowledged for the loan of specimens of *Corispermum*.

After a study of previous descriptions, the species descriptions herein were written to emphasize those specimens examined which represented the broadest range of morphological variation. Type citations (for all types seen) are included with the synonyms (pertinent to North America) following the correct name of each species.

By surveying state and regional floras and examining labels of herbarium specimens, a more current geographic range was established for each taxon. Specimens were selected for citation on the basis of this distributional survey. They are thus representative of the range of *Corispermum* in North America as it is now known. A card file will be maintained for all specimens examined. Each specimen's card typically includes information on the following: name of specimen, herbarium from which it was received, accession number, collector, collection number, date of collection, and habitat.

GENERIC DESCRIPTION

CORISPERMUM L., Species Plantarum 1:4. 1753.

Branched annual herbaceous plants, frequently slightly woody, glabrous to pubescent, the pubescence of stellate hairs; height of mature plant highly variable in response to climatic and edaphic factors. Leaves green (more rarely tinged with purple), alternate, simple, linear, sessile, entire, often deciduous early, those of the inflorescence reduced to bracts (which are slightly scarious-margined). Flowers perfect, axillary, arranged in spikes; perianth segments sepalloid, hypogynous, whitish, scarious, 1—3 (when 3 the posterior segment largest, the 2 anterior ones smaller); stamens 1—3, hypogynous, becoming exserted; ovary superior, the stigmas 2. Fruit achene-like, strongly exserted from perianth, flattened, oval to rounded-oval, often convex on the dorsal surface and concave on the ventral surface; pericarp somewhat hardened and closely surrounding the seed, the margin winged or not. Seed vertical; embryo annular, surrounding copious endosperm. Flowers and fruits developing late summer through autumn.

Type species: *Corispermum hyssopifolium* L., Species Plantarum 1:4, 1753.

The name *Corispermum* is derived from the Greek words *coris*, bedbug, and *sperma*, seed. Vernacular names include: bugseed, bugweed, and tick-seed.

SPECIES OF *CORISPERMUM* IN NORTH AMERICA

There are three species of *Corispermum* in North America; all three have been introduced. They are regarded as introduced species on the basis of their similarity to Old World material, the time of their recorded appearance in the North American flora, and their ruderal pattern of distribution. Statements in the literature also support their introduced status. Distributional data accumulated in this study indicate, in comparison with previously available information, an increasing range for all three species of *Corispermum* in North America with time.

A. Fruit conspicuously wing-margined.
  B. Spikes dense; bracts closely overlapping and all at least as broad as the fruit. . . . . 1) *C. hyssopifolium*
  B. Spikes loose; bracts not distinctly overlapping, especially along lowermost portion of spike, and at least the lower bracts much narrower than the fruit. . . . . 2) *C. nitidum*
A. Fruit lacking conspicuous wing-margins. . . . . 3) *C. orientale*

1. CORISPERMUM HYSSOPIFOLIUM L., Sp. Pl. 1:4. 1753. (Phototype: Linnaean Herbarium, IDC No. 12!)
  C. americanum Nuttall, Trans. Amer. Philos. Soc. 5:165. 1834.
  C. hyssopifolium var. *americanum* Nuttall, The Genera of North American Plants 1:3. 1818. (Type: *Nuttall s.n.*, PH!, labeled *C. hyssopifolium* var. *pubescens*)
  C. hyssopifolium var. *gracile* Hooker, Flora Boreali-Americana 2:125. 1838.
  C. hyssopifolium var. *robustius* Hooker, Flora Boreali-Americana 2:125. 1838.
  C. hyssopifolium var. *rubricaule* Hooker, Flora Boreali-Americana 2:125. 1838.
  C. imbricatum A. Nelson, Coulter's New Manual of Botany of the Central Rocky Mountains, revised ed., 163. 1909. (Type: *Elias Nelson 733*, RM!)
  C. marginale Rydberg, Bull. Torrey Bot. Club 30:247. 1903. (Holotype: *Herrick s.n.*, NY!)
  C. simplicissimum Lunell, Amer. Midl. Naturalist 1:207. 1910. (Type: *Lunell 395*, MIN!)

Stems slender to stout, glabrous to pubescent, the pubescence sparse to very dense. Leaves green, broadly linear, 0.5—9.0 cm long, 1.0—5.0 mm wide. Bracts linear to ovate, closely overlapping, at least as wide as fruit, as long as or longer than fruit, narrowed at the apex. Spikes densely flowered, up to 9 cm long, the spike axis not exposed. Fruits 1.0—4.0 mm wide, strongly wing-margined, the wing pale, up to 0.5 mm wide.

The specific name is derived from the Greek *hyssopos*, an aromatic herb.

Type locality: along the Volga River, U.S.S.R.

The North American specimens of *Corispermum hyssopifolium* do not

differ distinctly from Old World specimens of this species. Also, previous descriptions of *C. hyssopifolium* from both North America and the Old World are quite similar. Thus, the various specific and varietal names which have been recognized as applying to distinct taxa are reduced to synonyms.

Representative specimens: CANADA: ALBERTA: Bonnyville, railway gravel, 23 Sep 1939, *Grob 1099* (TEX, UC); Cardston, gravel soil, Lee's Creek, 8 Aug 1914, *Moodie 206* (NY); Craigmyle District, in grain crop, 30 Aug 1942, *Brinkman 5326* (OSC, RM); Fort Saskatchewan, 4 Sep 1939, *Turner 1574* (GH). MANITOBA: Glenboro, 35 mi SE of Brandon, prairie sandhills, 24 Aug 1951, *Scoggan 10545* (GH); Sidney, three mi E of here, 5 Sep 1954,*Rossbach 78* (UC). ONTARIO: Thunder Bay District, railroad ballast, north shore of Lake Superior, 13 Aug 1937, *Hosie, Losee, and Bannan 1461* (GH); Rainy River District, on railroad ballast, prostrate, 15 Aug 1961, *Garton 9438* (MIN); Welland Co.: Point Abino, 23 Aug 1886, *Coville s.n.* (MO). QUEBEC: Abitibi Co.: Villemontel, railroad ballast, 31 Aug 1952, *Baldwin and Breitung 4320* (GH); Labelle Co.: 8 Oct 1949, *Giroux s.n.* (MU). NORTHWEST TERRITORIES: Mackenzie District, disturbed sand along roadside on mainland one mile south of Fort Simpson Island, 3 Aug. 1955, *Cody and Matte 9130* (F, GH, MIN); Mackenzie District, five miles upstream from Norman Wells, rare on gravel beach of Mackenzie River, 27 Jul 1953, *Cody and Gutteridge 7603* (F); Mackenzie District, vicinity of Fort Simpson, windblown sand along river channel, 22 Aug 1939, *Raup and Soper 9868* (MIN, RM).

MEXICO: State of Chihuahua: Quarry hills, 1912, *Stearns s.n.* (MO).

UNITED STATES: ALASKA: Porcupine River, 15 mi from mouth, 22 Aug 1926, *Murie 49* (US); Yukon River between Rampart and Tanana, 9 Aug 1932, *Palmer 13* (US). ARIZONA: Navajo Co.: Holbrook, 4 Oct 1897, *Zuck s.n.* (US). CALIFORNIA: Inyo Co.: scattered on lower slopes of sand dunes at mouth of Marble Canyon, 13 May 1955, *Roos 6361* (UC). COLORADO: Jackson Co.: San Luis Valley, 1875, *Brandegee s.n.* (UC); Larimer Co.: North Park, 5 Sep 1899, *Osterhout 3201* (RM); Moffat Co.: three mi NW of Sunbeam, sand blow-out, 2 Sep 1970, Weber 14246 (US, UT); Weld Co.: 1909, *Johnston 618* (RM). IDAHO: Kootenai Co.: near Horse Plains Mountain, 25 Aug 1895, *Leiberg 1602* (MO, NY, UC); Nez Perce Co.: sandy island in Clearwater River, opposite Lewiston, 12 Oct 1924, *St. John 6792* (NY, UC). ILLINOIS: Cook Co.: Evanston, Sep 1888, *Johnson s.n.* (UC); Lake Co.: Winthrop Harbor, 30 Aug 1909, *Gates 3226* (F). INDIANA: Howard Co.: Kokomo, 1942, *Ek s.n.* (GH, MO, MU, NY, TEX, UC); La Porte Co.: Michigan City, 30 Sep 1920, *Benke 2749* (F); Porter Co.: Ogden Dunes, 4 Oct 1930, *Standley 57479* (F). IOWA: Harrison Co.: moist sandy alluvium along Missouri River, 9 Aug 1952, *Fay 4703* (UC). MICHIGAN: Berrien Co.: in sandy soil close to Lake Michigan in Bridgman, 20 Sep 1952, *Swink 1891* (F); Leelauna Co.: on open and exposed places, 13 Sep 1917, *McCoy 1037* (F); Manistee Co. Manistee, in sand on lake shores, 21 Aug 1882, *Morong s.n.* (NY); Mason Co.: sand-flats at Ludington, shore of Lake Michigan, 2 Oct. 1949, *McVaugh 11198* (MO). MINNESOTA: Polk Co.: dry sand about one mi SW of Fertile, 22 Aug 1947, *Terrell 1827* (MIN, US); Roseau Co.: ballast of railroad one and three tenths mi N of Longworth, 2 Aug 1939, *Moore and Moore 11370* (MIN, NY, UC); St. Louis Co.: Duluth, Minnesota Point, 6 Sep 1936, *Lakela 1841* (F, NY, PH); Todd Co.: Staples, sandy soil, 29 Aug 1911, *Chandonnet s.n.* (MO). MISSOURI: Clay Co.: Quo River, rare, 21 Sep 1895, *Mackenzie 1053* (NY); Perry Co.: Wittenburg, sand dunes along Mississippi River flood plain, 31 Jul 1934, *Steyermark 14056* (NY); St. Louis Co.: Chain of Rocks, Missouri River sand dunes, 5 Oct 1933, *Kellogg s.n.* (MO). MONTANA: Cascade Co.: Great Falls, Aug 1895, *Anderson s.n.* (MU, NY); Dawson Co.: sandy soil near Glendive, 6 Sep 1892, *Sandberg, MacDougal and Heller 1013* (F, GH, NY, US). NEBRASKA: Kearney Co.: Minden, sandy soil, 20 Sep 1907, *Hapeman s.n.* (MIN); Lancaster Co.: Lincoln, Aug 1898, *Williamson s.n.* (PH). NEW JERSEY: Nassau Co.: Bayville, 7 Jul 1935, *Murray s.n.* (MU). NEW YORK: Erie Co.: Buffalo, *Clinton s.n.* (F, NY). NORTH DAKOTA: McHenry Co.: sand blow-out, four to five mi W of Denbigh, 13 Sep 1932, *Hotchkiss 4505* (US); Pierce Co.: Rugby, railroad, 30 Jul 1912, *Bergman 2588* (MIN, MO); Richland Co.: Leonard, sand dunes, 19 Sep 1937, *Stevens 79* (F, NY); Stark Co.: Dickinson, on river bank, 18 Jul 1911, *Bergman 1257* (F). OHIO: Huron Co.: freight yards, Jul 1915, *Shuman 965.1* (OSU). OREGON: Baker Co.: 28 Nov 1952, *Wright s.n.* (OSC); Josephine Co.: Grants Pass, Sep 1887,

Howell s.n. (OSC); Lake Co.: near Alkali Lake, 18 Jul 1933, *Thompson 12,172* (F, GH, MO, NY, UC, US); Wasco Co.: along Columbia River opposite The Dallas, 1915, *Evans s.n.* (OSC). SOUTH DAKOTA: Fall River Co.: sandbars Cheyenne River, 12 Sep 1924, *Over 15943* (UC); Walworth Co.: sandbars Missouri River, 28 Aug 1921, *Over s.n.* (US). TEXAS: Webb Co.: Laredo, Rio Grande River, 1-20 Aug 1879, *Palmer 1165* (MO). UTAH: Juab Co.: Lynndyl sand dunes, 8 Sep 1965, *Welsh and Moore 5127* (MIN, NY); Millard Co.: juniper association, sand dune, 18 Sep 1926, *Garrett 1010* (RM). WASHINGTON: Douglas Co.: jct. of Crab and Wilson Creeks, 25 Jul 1893, *Sandberg and Leiberg 309* (F, GH, MO, NY, UC, US); Grant Co.: sandy sagebrush plains near Quincy, 15 June 1931, *Thompson 6764* (GH, MO); Klickitat Co.: sandy banks of the Columbia River, 11 Sep, 20 Oct 1893, *Suksdorf 1385* (F, GH, MIN, MO, NY, UC, US); Whitman Co.: sandy bank of Snake River at Wawawai, 15 Oct 1939, *Ownbey and Ownbey s.n.* (MIN, NY, RM, TEX, UC). WISCONSIN: Kenosha Co.: moist prairie along Lake Michigan, 16 Oct 1961, *Iltis 19,461* (TEX); Milwaukee Co.: Milwaukee, sandy lake beach, 1866, *Lapham s.n.* (MO); Racine Co.: Racine, 10 Sep 1878, *Davis 41* (MIN, MON, OSU); Sheyboygan Co.: sandy beach of Lake Michigan, 10 Sep 1956, *Iltis and Koeppen 8247* (UC). WYOMING: Sweetwater Co.: on sand dune one mi W of Steamboat Mountain, 2 Sep 1936, *Lang 99* (RM).

2. CORISPERMUM NITIDUM Kitaibel ex Schultes, Österreichs Flora, revised ed., 1:7. 1814.
   C. hyssopifolium var. *microcarpum* Watson, Proc. Amer. Acad. Arts 9:122. 1874. (Lectotype: *Fendler 711*, MO!)
   C. microspermum Host, Flora Austriaca 1:318. 1827
   C. tenue Link, Jahrbücher der Gewächskunder 1:27. 1820.

Stems slender, glabrous or more rarely sparsely pubescent, the pubescence denser in younger plants. Leaves green, narrowly linear, 0.5—6.0 cm long, 0.5—3.0 mm wide. Bracts commonly not imbricate, exposing the spike axis, only rarely slightly overlapping at apices or slightly telescoped in immature plants, the lower bracts much narrower than the fruit, frequently longer than fruit. Spikes not congested, up to 15 cm long. Fruits green to black, 1.0—3.0 mm wide, strongly wing-margined, the wing pale, up to 0.3 mm wide.

The specific name is from the Latin *nitidus*, bright.

Type locality: Hungary.

This plant is recognized in both the Old and New World as an excellent source of forage for cattle. Many members of the Chenopodiaceae, including *Corispermum*, are at least somewhat halophytic or salt-tolerant. As a result, this plant can establish itself in many areas where other species cannot. It is especially common along roadsides and in waste places.

The selection of the lectotype of *Corispermum hyssopifolium* var. *microcarpum* Watson is made herein from among the syntypic collections cited by Watson (1874).

Representative specimens: CANADA: MANITOBA: Grande Clariete, W of Hartney, dry sandy clearings in dune area, 29 Jul 1951, *Scoggan 10142* (MIN); St. Lazare, 70 mi NW of Brandon in valley of Assiniboine River opposite mouth of Qu'Appelle River, prairie sandhills, 7 Aug 1951, *Scoggan 10246* (GH, MIN). ONTARIO: Rainy River District, on panne of sand dunes, 1 Aug 1961, *Garton 9148* (UC); Thunder Bay District, waste ground, staff parking lot Lakehead University, 10 Aug 1972, *Garton 15175* (UC). MEXICO: State of Chihuahua: sand dunes, 10-19 Oct 1935, *LeSueur 285* (F, MO, TEX, UC).

UNITED STATES: ARIZONA: Apache Co.: Adamana, 6-15 Aug 1903, *Griffiths 5074* (US); Coconino Co.: marsh near Tuba City, 27 Sep 1935, *Kearney and Peebles 12875* (F); Navajo Co.: Holbrook, 6 Sep 1883, *Rusby s.n.* (F, NY, US). COLORADO: Boulder Co.: plains and foothills near Boulder, Oct 1902, *Tweedy 5088* (NY, RM); Denver Co.: Denver, along the Platte River, 19 Aug 1878, *Jones 655* (MO); Freemont Co.: Canon City, Sep 1873, *Brandegee 841* (MO, NY, UC); Weld Co.: New Windsor, 14 Sep. 1896, *Osterhout 1156* (RM). ILLINOIS: Cook Co.: Chicago, 14 Sep 1954, *Thieret 1033* (F); Menard Co.: Athens, 1861, *Hall s.n.* (MO). INDIANA: Lake Co.: in sandy beach along railroad tracks E of Indiana Harbor, 23 Sep 1906, *Deam 1746* (NY, RM, US); La Porte Co.: Michigan City, 7 Sep 1903, *Lansing, Jr. 1886* (F). KANSAS: Barber Co.: Medicine Lodge, bottom of dry ditch, 12 Sep 1890, *Smyth 300* (GH, NY); Greeley Co.: Tribune, 2 Sep 1893, *Reed s.n.* (MU, NY, US); Logan Co.: sandy soil, 27 Jul 1895, *Hitchcock 441* (GH, MO, NY, RM, US); Rooks Co.: Rockport, 1889-1894, *Bartholemew s.n.* (NY). MICHIGAN: Berrien Co.: Benton Harbor, sandy shore of St. Joseph River, 18 Sep 1910, *Lansing 2884* (GH); Calhoun Co.: W of Albion, 22 Sep 1906, *Barr s.n.* (F); Mason Co.: Ludington, Hamlin Lake, moving dune, 14 Sep 1910, *Chaney 211* (F, GH, NY, US). MINNESOTA: Clearwater Co.: Squaw Lake, 25 Aug 1936, *Grant 6830* (MIN); Goodhue Co.: sandy soil Cannon Falls, Jul 1893, *Scofield s.n.* (GH); Hennepin Co.: Minneapolis, Jul 1890, *Aiton s.n.* (RM); Ottertail Co.: Battle Lake, Aug 1892, *Sheldon s.n.* (MIN, MO, OSU, UC). NEBRASKA: Hooker Co.: on Middle Loup River near Mullen, 17 Jul 1893, *Rydberg 1647* (NY, US); Kearney Co.: Minden, 30 Aug 1891, *Hapeman s.n.* (RM); Thomas Co.: Middle Loup River near Nattick on sandy bank, 11 Sep 1893, *Rydberg 1647* (NY, US). NEW MEXICO: Dona Ana Co.: Mesilla Valley, 20 Sep 1907, *Wooton and Standley 3154* (F, MIN, MO, OSC, RM); Otero Co.: dunes of quartz sands, 14 mi W of Tularosa, 13 Oct 1931, *Brum s.n.* (UC); San Juan Co.: Farmington, 8 Aug 1904, *Wooton 2764* (US); Socorro Co.: 27 Aug 1965, *Hess, Dunn and Spellman 419* (GH). NEW YORK: Monroe Co.: East Rochester along railroad track, 15 Sep 1921, *Baxter 5499* (GH, NY). NORTH DAKOTA: Ranson Co.: Anselm, 30 Aug 1918, *Stevens s.n.* (MIN). OHIO: Ross Co.: Chillicothe, B & O Railroad, 12 Sep 1965, *Bartley 1078.1* (NY, OSU). OKLAHOMA: Canadian Co.: floodplain of the South Canadian River E of Bridgeport, 6 Oct 1940, *Waterfall 2507* (MO, NY); Cleveland Co.: sand near river, 10 mi NW of Norman, 8 Sep 1946, *Goodman 4080* (MO, RM); Woods Co.: on sandy bank of Salt Fork River near Alva, 24 Sep 1913, *Stevens 2849* (GH, MIN, MO, NY, US). SOUTH DAKOTA: Clay Co.: sandy flood plain of Vermillion River, 25 Sep 1914, *Over 5110* (US); Harding Co.: Cave Hlls, steppe, 1 Sep 1912, *Visher 668* (F). TEXAS: El Paso Co.: on dunes about 10 mi NW of El Paso, W of Franklin Mountains, 30 Oct 1962, *Correll 26570* (GH); Hemphill Co.: gravel dikes in sand hills two mi S of Glazier, 8 Oct 1965, *Rowell 10919* (GH); Lipscomb Co.: deep sands of sand hills one mi S of Higgins, 8 Oct 1965, *Rowell 10908* (GH); Wheeler Co.: flood plain, north fork of Red River, 15 Sep 1950, *Tharp and Miller 51-376* (MIN, RM, TEX). UTAH: Emergy Co.: vicinity of Molly's Castle, San Rafael Desert, 15 Aug 1957, *Mitchell and Grover s.n.* (NY); Salt Lake Co.: Bingham Canyon, 27 Aug 1879, *Jones 1341* (F, MIN, NY, RM, US); San Juan Co.: Lost Canyon, 15 Sep 1964, *Welsh, Moore, and Olsen 3763* (MIN). WASHINGTON: Grant Co.: dry sand SW of Moses Lake, 25 June 1921, *St. John, Courtney, and Parker 4948* (GH); Klickitat Co.: high sandy river bank, 16 Jul 1895, *Suksdorf 3675* (GH); Whitman Co.: woody bank of Snake River, 4 Oct 1924, *St. John s.n.* (UC). WISCONSIN: Racine Co.: 10 Sep 1878, *Davis s.n.* (F); Sheboygan Co.: occasional on dunes and sandy beaches, Lake Michigan area, 3 Sep 1939, *Pohl 1401* (PH).

3. CORISPERMUM ORIENTALE Lamarck, Encyclopédie méthodique botanique 2:110. 1786.

   C. emarginatum Rydberg, Bull. Torrey Bot. Club 31:404. 1904. (Type: *Aven Nelson 4282*, GH, MO, NY, RM!)

   C. orientale var. *emarginatum* (Rydberg) Macbride, Contr. Gray Herb. new series, 53:12. 1918.

   C. villosum Rydberg, Bull. Torrey Bot. Club 24:191. 1897. (Lectotypic collection: *Rydberg 2623*, NY, US!)

Stems glabrous or more rarely sparsely pubescent. Leaves linear, green

or occasionally tinged with purple, 0.5—6.0 cm long, 0.5—3.5 mm wide. Bracts overlapping, exposing the axis along the lower portion of the inflorescence, at least as broad as and commonly slightly longer than the fruit, narrowed at apex. Spikes densely flowered, up to 13 cm long. Fruits 1.0—3.5 mm wide, lacking distinct wing margins though the margin of the fruit may be sharpened or acute.

The specific name is derived from the type locality: "in Oriente." The type specimen is maintained in Paris (P).

The selection of the lectotypic collection of *C. villosum* was actually made by Standley (1916) when he chose Manhattan, Montana, as the type locality.

Immature specimens of *C. orientale* and *C. hyssopifolium* are somewhat similar in appearance; however, *C. hyssopifolium* can be distinguished from *C. orientale* in immature stages by the degree of pubescence on the inflorescence. The inflorescence of *C. hyssopifolium* (especially in younger plants) tends to be very densely pubescent, whereas that of *C. orientale* is seldom pubescent, even during early stages of development.

The New World and Old World specimens of *C. orientale* are virtually identical. Although Macbride (1918) was correct in proposing that *C. villosum* and *C. emarginatum* are not native species, that they do in fact represent the same taxon, and that they are actually *C. orientale*, he suggested that North American specimens differed enough from Old World material to be recognized as a distinct variety, viz. *C. orientale* var. *emarginatum* (Rydberg) Macbride. Careful attention was given to Macbride's description, but no distinguishing features were observed among the specimens which would support the proposed variety. Consequently, only one nonwing-margined species (without varieties) should be recognized among the North American taxa of *Corispermum*.

Representative specimens: CANADA: ALBERTA: Cardston, vicinity of Calgary, 8 Aug 1914, *Moodie* 6 (F); Fort Macleod, 6 Aug 1895, *Macoun 12,935* (F). ONTARIO: Lambton Co.: Port Franks, 15 Oct 1906, *Dodge s.n.* (MU, TEX); Rainy River District, gravel railroad ballast, 15 Aug 1961, *Garton 9383* (MIN); Thunder Bay District, Port Arthur, railroad ballast, 6 Sep 1952, *Garton 2209* (MO). SASKATCHEWAN: Medicine Hat, 9 Aug 1895, *Macoun 12936* (NY); Webb, sand dunes, 29 Aug 1947, *Breitung 5842* (MO). MEXICO: State of Chihuahua: much branching forming sand tuft, 1852, *Thurber s.n.* (F).

UNITED STATES: ARIZONA: Apache Co.: Canyon de Chelly National Monument, dry sandy areas in canyon, 17 May 1955, *Demaree 38425* (UT); Coconino Co.: Flagstaff, 5 Sep 1943, *Schallert s.n.* (MO, RM). COLORADO: Chaffee Co.: Salida, 31 Aug 1892, *Mulford s.n.* (MIN); El Paso Co.: Colorado Springs, 11 Aug 1873, *Porter s.n.* (RM); Gunnison Co.: Gunnison, along irrigation ditches and adjacent dry ground, 12 Sep 1901, *Underwood and Selby 401* (NY); Moffat Co.: infrequent on dry sandy areas one-quarter mi W of Echo Park Campground, 7 Sep 1961, *Holmgren, Jensen, and Reveal 438* (NY). MICHIGAN: Marquette Co.: Marquette, 1 Sep 1923, *Sherff s.n.* (F). MINNESOTA: Clay Co.: Dilworth, railroad yards, 22 Sep 1958, *Stevens 2033* (MIN, UC); Lake of the Woods Co.: Morris Point (Oak Point), growing on sandy shore, 29 Aug 1939, *Moore and Moore 12226* (GH, RM); St. Louis Co.: Duluth, in gravel common on the beaches of the lake and bay, 22 Aug 1936, *Lakela 1770* (NY, US). MISSOURI: Clay Co.: common, 21 Sep 1895, *Mackenzie 422* (MO, NY); Jackson Co.: Kansas City, sands, 24 Sep 1909, *Bush 5923* (GH, MIN, MO, NY, US); Ray Co.: sandbars and alluvial depressions along Missouri River, 5.5 mi SE of Henrietta, 9 Oct 1956, *Steyermark 83150* (MO). MONTANA: Daw-

son Co.: Colgate, 6 Sep 1892, *Sandberg, MacDougal, and Heller 1013* (US); Hill Co.: Havre, 4 Sep 1903, *Blankinship s.n.* (RM). NEW MEXICO: Bernalillo Co.: Albuquerque, Aug 1884, *Jones 4936* (NY); Sandoval Co.: San Ysidro, 18 Aug 1926, *Arsene and Benedict 16476* (F, US); Santa Fe Co.: Santa Fe, 10 Sep 1881, *Engelmann s.n.* (MO); Valencia Co.: Grants, 1 Oct 1884, *Jones 4936* (US). NORTH DAKOTA: Billings Co.: Medora, in sand near top of butte, 17 Sep 1911, *Bergman 1284* (RM); Cass Co.: Fargo, in sand on railroad grade, 12 Sep 1942, *Stevens 669* (MO, NY, UC); Morton Co.: Mandan, 10 Sep 1891, *Wright 610* (NY, RM). OREGON: Walla-Walla Co.: 17 Sep 1894, *Leiberg 912* (GH, MO, NY, US). TEXAS: Wilbarger Co.: Sep 1880, *Boll 1232* (F). WISCONSIN: Ashland Co.: railroad tracks, 10 Sep 1927, *Penokee 16282* (MO). WYOMING: Albany Co.: Laramie, saline creek bank, 22 Aug 1913, *Macbride 2699* (MO); Sweetwater Co.: sand dunes near Steamboat Mountain, 1 Sep 1936, *Ownbey and Lang 1122* (MO); Uinta Co.: Diamondville, on the loose railroad grades, *Nelson 8109* (GH, MIN, MO, NY, RM, US).

DOUBTFUL SPECIES

Corispermum pilosum Rafinesque, New Flora and Botany of North America 4:46. 1836.

Originally collected by Kin (or Kinn) in Florida (Rafinesque, 1836), no specimens of this species have been collected in recent years. Standley (1916) suggested that this plant may be *C. hyssopifolium* L., if it was in fact correctly placed in this genus.

DISTRIBUTIONAL HISTORY OF *CORISPERMUM* IN NORTH AMERICA

The increased distribution of all three species of *Corispermum* with time appears to be associated with two major factors of seed dispersal, waterways (rivers, streams, lakes) and transport along thoroughfares. A third, but relatively minor (operating within a smaller range), factor is wind. Wind, particularly for those populations which have become established on sand dunes, could account for seed dispersal across a distance of several miles.

In Canada the range of *Corispermum* appears to have increased northward and westward with time. This statement is based on herbarium specimens examined. Many of these Canadian specimens were collected on or near military camps, and the increase in range of *Corispermum* may have accompanied the establishment of these camps.

The range of *Corispermum* in Mexico seems fairly limited; however, all three species are present and apparently have been for some time (i.e. since at least 1912 for *C. hyssopifolium*, 1935 for *C. nitidum* and 1852 for *C. orientale*). Thus, it is probable that their distribution in Mexico is greater than our findings indicate. This could be a result not only of the herbaria selected for this study, but also of the general incompleteness of representative herbarium material available from this region.

On the basis of specimens examined it is not possible to indicate a certain point of origin for each species in the United States nor exact pathways of establishment. However, during the course of this study several locations of early establishment became apparent. Again, these are not necessarily indications of points of origin, but are only suggested population centers

for each species early in the history of *Corispermum* in the United States.

It is postulated that the earliest representatives of the genus (i.e. *C. hyssopifolium*) in the United States became established just prior to 1818 (Nuttall), somewhere in the midwest. The establishment of all three species since that time has been successful throughout a major portion of the country. Populations of both *C. nitidum* and *C. hyssopifolium* in the Great Lakes region and in several states along the Missouri River were some of the earliest populations of *Corispermum* collected for herbaria. From these centers, the species' rapid spread would have been facilitated by major waterways. Based on numbers of herbarium specimens examined, both *C. nitidum* and *C. hyssopifolium* appear better established than *C. orientale*, and *C. hyssopifolium*, of the first two, is probably the more widespread. Earliest specimens of *C. orientale* were from New Mexico and Texas in the late 1800's (circa 1880). However, *C. orientale* is now rather widely distributed throughout the United States. The establishment of *C. orientale* in many areas seems to be associated with transport routes, particularly railways, and is thus more recent than that of the other two species. Consequently, it is postulated that, with time, *C. orientale* will become as successful in North America as *C. nitidum* and *C. hyssopifolium*.

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NOTES

ADDITIONS TO THE TEXAS FLORA—Recent collections sent to the SMU Herbarium for identification from the Texas Parks and Wildlife Department have yielded a number of additions to the Texas flora. I acknowledge help from David Riskind of that Department and from the New York Botanical Garden for loan of a specimen.

Holcus lanatus L. Harrison Co.: Caddo Lake State Park, 27 Jul 1976, *Fleetwood 11746* (SMU); duplicate at TAES. This was reported by Silveus (1933) from Beaumont, Texas, and was listed for Texas by Gould (1975), who cited no voucher specimen. A duplicate collection was sent to Frank Gould of Texas A&M University for verification.

Eleocharis baldwinii (Torr.) Chapm. Harrison Co.: moist site along boat ramp in Caddo Lake State Park, 15 Jul 1975, *Fleetwood 11833* (SMU). This species, included in Correll & Johnston (1970) although no collections were known for the state, was to be expected in eastern Texas. Svenson (1937) cited a collection from Caddo Parish, La.: sandy silt on margin of Caddo Lake near Oil City, 23 Sep 1934, *Uhler & Kubichek* (B). The western part of this lake extends into Harrison County, Texas.

Cardamine pensylvanica Muhl. This crucifer was included in the state's flora by Cory & Parks (1937) and by Gould (1969). Correll & Johnston (1970) noted that the species had been reported for the state, but they excluded it because they had not seen specimens from Texas. The following Texas collections are now available. Dallas Co.: weed under lath, mostly along walks in clay, Northhaven Gardens, north Dallas, 6 Nov 1960, *Shinners 29514* (SMU). Harris Co.: sandy soil of backyard, 400 block Southchester Road, Houston, 16 Mar 1976, *Smith 15* (SMU). Liberty Co.: along roadside of hwy. 787 near Melvid, 25 Mar 1971, *Amerson 335* (SMU). This is a species similar to *C. parviflora* var. *arenicola* but with the terminal leaflet larger than the lateral ones and the stems usually hispid near the base.

Plantago rugelii Dcne. This is a widespread perennial species primarily in the eastern half of the United States and southern Canada. Although early reported for Texas by Coulter (1891-1894) and later by Cory & Parks (1937), it has been consistently omitted from more recent treatments of the state's flora, e.g., Shinners (1950, 1958), Gould (1969), Correll & Johnston (1970), and Correll & Correll (1972). Small (1933) and Steyermark (1963) included Texas in the range of *P. rugelii.*

The species is morphologically similar and closely related to the more widespread but less common *P. major.* They may be separated as follows (Steyermark, 1963).

Mature fruit dehiscing transversely between the base and the middle, seeds 4—9; sepals and bracts subacute to acute; bracts triangular-lanceolate; base of petioles usually dark red-purple. . . . *P. rugelii*

Mature fruit dehiscing transversely near the middle, seeds 6—15; sepals and bracts rounded or obtuse; bracts broadly ovate; base of petioles usually green. . . . . *P. major*

Originally I was going to report this species for Texas based on a single collection from Titus County. While going through Bassett's *Plantains of Canada* (1973), I noted on a distribution map two dots in Texas. Correspondence with Mr. Bassett, made in an attempt to locate these collections, elicited the response that he had not kept records and thus was uncertain of the herbarium or herbaria in which Texas specimens of *P. rugelii* were deposited.

The following voucher collections will document the long-time presence and the continued existence of this species in Texas. Dallas Co.: damp woods, Dallas, Jul 1877, *Reverchon s.n.* (NY). Grayson Co.: Denison, 31 Aug 1936, *Tharp s.n.* (SMU). Titus Co.: near Swanano Creek N of hwy. 11 between Cason and Pittsburg, 16 Jun 1973, *Amerson & Riskind 1812* (SMU).

Helianthus strumosus L. This widespread, summer-flowering species of central and southeastern United States was previously reported from Texas by Heiser (1969). Correll & Johnston (1970), however, did not include *H. strumosus* in the Texas flora. The following collections are voucher specimens from northeastern Texas. Harrison Co. Caddo Lake State Park, 27 Jun 1975, *Fleetwood 11699* (SMU); 30 Jun 1975, *11761* (SMU); 15 Jul 1975, *11783* (SMU); 30 Jul 1975, *11791, 11796* (SMU).

Helianthus strumosus is a perennial species closely related to *H. tuberosus* but differing primarily in having generally smoother stems, in the absence of glands on the lower leaf surface, and in the rhizomes not being tuberous.

Senecio vulgaris L. This was reported for Texas by Cory & Parks (1937) and by Gould (1969). It is, however, omitted from Correll & Johnston (1970). A recent collection of *S. vulgaris* in north central Texas has led to the discovery of earlier collections of this species in the SMU herbarium. The following are voucher specimens. Dallas Co.: weed in flower bed in black clay, University Park, Dallas, 13 May 1958, *Shinners 27305* (SMU); weed under lath, sandy loam, Northaven Gardens, north Dallas, 6 Nov 1960, *Shinners 29156* (SMU); in bed of evergreens, 1950 N Industrial Blvd., 28 Apr 1970, *Flyr 1382* (SMU); open field behind Faircrest St. near Lake Highlands High School, 7 Mar 1977, *McGehee 90* (SMU). Wichita Co.: lawn weed next to driveway, W side of City Lake in Iowa Park, 10 Apr 1971, *Mahler 6420* (SMU).—*Barney Lipscomb, Herbarium, Southern Methodist University, Dallas, TX 75275.*

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NOTEWORTHY VASCULAR PLANT RECORDS FROM TEXAS—Recent collections from units of the state park system as well as from natural resource investigations involving the Texas Parks and Wildlife Department have yielded several distribution records of note.

Sporobolus silveanus Swallen. This species was previously known, in Texas, from the southeastern counties of Brazos, Hardin, and Orange. (Gould, The grasses of Texas, 1975). *Sporobolus silveanus* is reported here as occurring in far northeastern Texas in Lamar County, the following collection representing a disjunction of at least 350 km north of the nearest known Texas locale: Lamar Co.: *Tridens* prairie at intersection of hwy. 82 and farm road 32 ca. 7 miles W of Paris, Nov 1971, *Collins s.n.* (LL). *Sporobolus silveanus* constitutes ca. 57% basal cover in the *Tridens* prairie community. Associated species included *Andropogon gerardi, Desmanthus illinoensis, Helianthus hirsutus, H. maximilianii, Manisuris cylindrica, Paspalum floridanum, Sorghastrum avenaceum, Tridens strictus,* and *Tripsacum dactyloides.*

Menispermum canadense L. Recent collections from Bandera and Real counties document the rediscovery of *Menispermum* in Texas—where it had not been collected in over 70 years. The first known Texas collection is: Dallas Co.: rare in woods, 30 Aug 1901, *Reverchon 2733* (GH, SMU). Shinners included the species in his *Spring flora of the Dallas-Fort Worth area, Texas* (2nd ed., 1972). However, Correll & Johnston (*Manual of the vascular plants of Texas,* 1970) and Stanford (*Keys to the vascular plants of the Texas Edwards Plateau and adjacent areas, 1976),* do not report this taxon in their manuals. The following collections document *M. canadense* in Texas: Bandera Co.: Lost Maples State Natural Area, clambering over herbs and rocks and climbing into shrubs and trees in rocky stream bottom. Abundant within ca. 0.5 hectare. Associated with *Aesculus pavia* var. *pavia, Diospyros, tex-*

ana, *Juglans major*, *Juniperus ashei*, *Prunus serotina*, *Quercus texana*, *Tilia floridana*, and *Verbesina virginica*, 23 Apr 1974, *Snyder 232* (LL); 25 Jun 1976, *Riskind & Riskind 2002* (SMU). Real Co.: climbing over shrubs, herbs, and rocks in bed of Can Creek in Lost Maples State Natural Area, 18 Jun 1975, Smith 693 (LL). The nearest known populations of *M. canadense* are in Caddo and Canadian counties, Oklahoma (Rice, The microclimate of a relict stand of sugar maple in Devil's Canyon in Canadian Co., Oklahoma, Ecology 41:445-453.1960; Little, The vegetation of the Caddo County canyons, Oklahoma, Ecology 20:1-10.1939). The species is also known from the mountains above Monterrey, Nuevo León, Mexico. No collections of *Menispermum* from intervening points are known to me. Populations of *Menispermum* in the Lost Maples State Natural Area have been observed for 2 years, and no fruiting individuals seen; the population appears to be unisexual. All collections made were from staminate plants.

Acer grandidentatum Nutt. Canyon big-tooth maple is a common temperate deciduous small tree in mesic canyon woodlands of moderate elevations in mountains of northern Mexico and southwestern and western United States, north to Utah and Wyoming. The species is localized but well represented in certain deeply entrenched, mesic limestone canyons on the southern portion of the Balcones Escarpment in Texas as far east as Kendall County. Most *A. grandidentatum* of the Edwards Plateau and neighboring areas has been referred to the var. *sinuosum* (Rehd.) Little. Recently discovered stands of *A. grandidentatum* in Bell County, ca. 220 km north northeast of the Balcones Escarpment populations, appear closest to the western var. *brachypterum*, based upon leaf morphology. Bell Co.: exposed slopes and creekbeds of rocky limestone soils in intermittent tributary of Bear Creek, Fort Hood Military Reservation, 6 Jun 1976, *Riskind & Snyder 1993*, *1997*, *1999* (NY, SMU); 6 Jun 1976, *2000* (NY).

Bignonia capreolata L. *Bignonia capreolata* is a common high-climbing liana in eastern Texas pinywoods and points east. A recent collection on the Balcones Escarpment is unusual and noteworthy: Bandera Co.: Sabinal Canyon ca. 7 miles N of Vanderpool, Warren Murphey Ranch, on steep limestone bluff ca. 100 ft above river, 8 Apr 1972, *Welborn s.n.* (LL). This area is now within Lost Maples State Natural Area. Welborn's collection represents a disjunction of ca. 410 km from the nearest known collection in Walker County and at least 270 km from a disjunct population along the Guadalupe River in Victoria County, 29 May 1932, *Tharp s.n.* (LL).

Gailum correllii Dempst. Heretofore known only from the type locality on limestone walls of Langtry Canyon (Mile Canyon) in Val Verde County (*Correll & Rollins 32612*) and limestone cliffs above Rio Grande in northwestern Coahuila, Mexico (*Johnston, Wendt, & Chiang 10607*). This species has recently been collected from vertical walls of a tributary canyon of the Rio Grande. Brewster Co.: local in limestone crevices at Waterworks

Canyon at Asa Jones, 1 Apr 1973, *Riskind 1016* (LL); 19 Oct. 1975, *1861a* (LL). Associated plants were *Cirsium turneri, Penstemon baccharifolius*, and *Perityle* cf. *parryi*. These collections represent range extensions upstream along the Rio Grande of ca. 100 km.

I acknowledge assistance from: Debbie Balser, Harold Beaty, Marshall Johnston, Barney Lipscomb, Larry Lodwick, Wm. F. Mahler, Jackie Smith, Bruce Snyder, and Carroll E. Wood, Jr.—*David H. Riskind, Resource Management Section, Texas Parks and Wildlife Department, Austin, TX 78744.*

CHROMOSOME NUMBERS OF *ASTER ERICOIDES* L. AND *ASTER PILOSUS* WILLD. (COMPOSITAE)—For the widespread, common *Aster ericoides*, there is but a single report of chromosome number: $2n = 32$ (Huziwara. Karotype analysis in some genera of Compositae. VIII. Further studies on the chromosomes of Aster. Amer. J. Bot. 49:116-119. 1962). In light of this single report, I undertook to confirm the determination. In two local populations (*Harriman 1278*, *Harriman 14,178*, in herb. OSH), I found repeatedly $2n = 10$ in root tips. Dr. Huziwara (of Kobe University, Japan) has kindly loaned to me the voucher specimen for his determination; the plant with which he worked proves to be *A. pilosus*, not *A. ericoides*. My report, then, establishes a correct number for *A. ericoides* but leaves open the question of whether *A. pilosus* should have as one of its chromosome numbers Huziwara's count of $2n = 32$, an anomalous number for a species in which $2n = 48$ and $n = 12$ have been reported (Van Faasen & Sterk, Chromosome numbers in asters. Rhodora 75:26-33. 1973). I examined one local population of *A. pilosus* (*Harriman 8822*, in herb. OSH) and likewise found $2n = 48$. I suggest that Huziwara's count is best treated as an error in *Aster*, perhaps stemming from some inadvertent mixing of seeds and specimens sent him by workers at the Montreal Botanical Garden.—*Neil A. Harriman, Biology Department, University of Wisconsin-Oshkosh, Oshkosh, WI 54901.*

ADDITIONS TO ALABAMA LYTHRACEAE.—Shirley A. Graham (Sida 6: 80-103. 1975) recently revised Lythraceae for the forthcoming *Vascular Flora of the Southeastern United States* (A. E. Radford *et al.*, editors). Recent collections, listed below, are additions to known ranges and supplement existing physiographic province records. These specimens are deposited in the Herbarium of the University of North Carolina at Chapel Hill (NCU).

Ammannia coccinea Rottb. ALABAMA. INTERIOR LOW PLATEAU: Franklin Co., *Whetstone & Massey 4426*; Lawrence Co., *Whetstone & Radford 7126*. CUMBERLAND PLATEAU: Cullman Co., *Whetstone & Atkinson 3610*; Etowah Co., *Whetstone & Radford 6868*; Jackson Co., *Whetstone & Radford 7489*. COASTAL PLAIN: Barbour Co., *Kral 33202* (*NCU 451006*). Heretofore, the documented distribution of this species included all provinces

of the southeast with the notable exception of Alabama.

Lythrum salicaria L. ALABAMA. CUMBERLAND PLATEAU: Madison Co., *Whetstone & Marx 8761.* The nearest known station for this species was Watauga County, North Carolina (*Taylor & Evans* 56, *NCU 382589*).—*R. David Whetstone, George R. Cooley Research Laboratory, Department of Botany, University of North Carolina, Chapel Hill, NC 27514.*

NOMENCLATURAL CORRECTION IN *CLEMATIS.*—During a revision of *Clematis* (see Sida 6: 36. 1975) for the forthcoming *Vascular Flora of the Southeastern United States*, I accepted the name *Clematis maximowicziana* Franchet & Savatier for the commonly cultivated clematis native to Japan which is now casually escaped throughout eastern North America. Meanwhile, Dr. L. A. Lauener (*in litteris*) kindly indicated that Hiroshi Hara (J. Japanese Bot. 50: 155-158. 1975) established the identity of *Clematis terniflora* DeCandolle (Syst. 1: 137. 1817), and which has priority over *C. maximowicziana.* After studying Hara's paper, I am prepared to accept his conclusion that *C. terniflora* is the correct name for the clematis passing variously as *C. paniculata* Thunberg (Trans. Linn. Soc. 2: 337. 1794, *non* J. F. Gmelin, Syst. 873. 1791), *C. maximowicziana* Franchet & Savatier (Enum. Pl. Japon. 2: 261. 1878), or *C. dioscoreifolia* Léveillé & Vaniot (Fedde, Repert. Nov. Sp. 7: 339. 1909). For a complete list of synonyms, consult Hara's paper.—*Carl S. Keener, 202 Buckhout Laboratory, The Pennsylvania State University, University Park, PA 16802.*

ERRATA

In my Notes on *Coreopsis* (SIDA 7:304-307. 1978), I accidentally gave credit to Rafinesque for the combination *C.* X *delphinifolia.* In the entries 3 and 21, this should be corrected to *C.* X *delphinifolia* Lam.—*Edwin B. Smith, Department of Botany & Bacteriology, University of Arkansas, Fayetteville, Arkansas, 72701.*

SIDA CONTRIBUTIONS TO BOTANY

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